

Subterranea

April 2013 Issue 32

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In This Issue...

Sand Mines in Reigate

Steam on the Underground

Peenemünde

Newcastle Air-Raid Shelters

Subterranea Britannica



www.subbrit.org.uk

Subterranea Britannica is a society devoted to the study of man-made and man-used underground structures and the archaeology of the Cold War. The society is open to all and its membership includes all walks of life. Members are invited to contribute to this magazine even if this just means sending very welcome snippets from newspapers and magazines.

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Front cover photo: One of the two parallel northeast/southwest tunnels in the Ashley Road deep shelter in Epsom. These were linked by six shorter cross tunnels. The shelter, which has been visited by Sub Brit members on numerous occasions, is to be converted into a secure gold vault. See news item on page 10. Photo Nick Catford

Back page upper: The bottom of the slope-shaft at Park Lane Quarry at Corsham. There was a rail incline to the left of the steps. This was used for hauling up rock. During the working week horses were stabled underground. They were brought up the incline in tubs at the weekend. Photo Dom Jackson

Back page lower: The Victoria Tunnel in Newcastle-upon-Tyne. The tunnel was built in 1842 as a 3.6km long underground wagonway from the Spital Tongues colliery down to riverside docks at Ouseburn. During WWII part of the tunnel was used as a public air-raid shelter. The section of tunnel seen here was limewashed at this time. Photo Chris Rayner

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However the Editor reserves the right not to publish material without giving a reason.

The committee of Subterranea Britannica and the Editor do not necessarily agree with any views expressed and cannot always check the accuracy of any material sent in.

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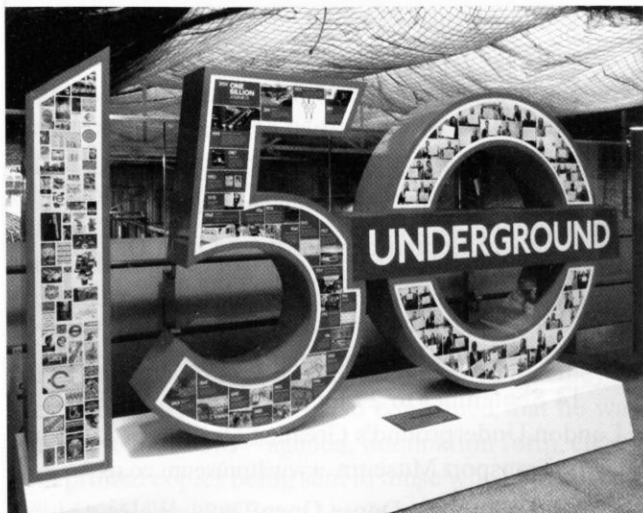
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Chairman's Welcome

Martin Dixon

A belated Happy New Year to all Sub Brit members. A particularly warm welcome to those who have recently joined us – I hope that your membership will be long and rewarding.



You would almost have to have been isolated in a locked-down bunker not to have noticed the recent celebrations of 150 years of the London Underground. The anniversary is being celebrated with TV and radio programmes, exhibitions, conferences, books, walks, talks and historical rolling stock – and, of course, mention in this very issue of *Subterranea*.

I enjoyed attending the recent Underground anniversary two-day conference at Senate House organised jointly by University College London and the London Transport Museum. The audience included around half a dozen Sub Brit members and it was amazing how many different aspects of the network featured in the presentations and

discussions. Some speakers majored on the engineering aspects, others the design leadership in (for example) maps, fonts and architecture.

At the other end of the spectrum, some contributors explored the contribution our capital's Underground has made to films and the arts, and the impact it has made to London's social scene. Yet others made comparative studies with metro systems across Europe and North America. Even the location was relevant as Senate House was designed by Charles Henry Holden – well known also for being the architect of 55 Broadway [headquarters of London Transport] and of many 1920s and 30s Underground stations.

As well as providing interest and entertainment to Sub Brit members, I believe that the Underground's 150th anniversary has demonstrated a number of aspects that also apply to underground heritage more generally:

- (1) There is a huge (sometimes latent) public interest in matters underground;
- (2) There are many dimensions that we can – and should – consider when studying our subterranean heritage; and
- (3) It is perfectly possible for modern-day business to coexist with historical studies and activity, as typified by the steam 'specials' on the Metropolitan and District lines.

The year has started with some cracking visits in the pipeline (pun intended) and we have some superb speakers at our Spring and Autumn Conferences. Keep an eye on the website Events page as other visits emerge. I hope to see many members out and about at these events.

chairman@subbrit.org.uk

Sub Brit Shop

A reminder that back issues of *Subterranea* and other Sub Brit publications can be viewed and ordered at the Sub Brit shop – linked from the home page of our website.

In addition, a selection of underground related books is displayed and can be purchased via Amazon. Sub Brit receives a small commission from all such sales.

Not only this, but if the Sub Brit portal is used to search Amazon (or bookmark www.subbrit.org.uk/amazon) then ALL purchases made (with just a few exceptions) benefit Sub Brit in this way.

Happy Shopping!

Sub Brit Visits Weekend : Devon

We are now able to confirm the date for the annual Sub Brit Visits Weekend.

This year it will be based in Devon; starting on Friday afternoon, 6 September, through to Sunday afternoon 8 September. Please see the enclosed leaflet for more details and a booking form.



SUBTERRANEA BRITANNICA DIARY

Summary of Forthcoming Events 2013

Sub Brit specific events

- 9 May Paddock open day
17-20 May SB Visits weekend to Gothenburg,
Sweden
25 May SB visit to Portland ROTOR Bunker &
Ridgeway Hill AAOR
15 June SB Committee meeting
6 - 9 September SB Visits weekend Devon
(See enclosed flyer)
21 September Paddock open day
19 October SB Autumn meeting

For more information, email info@subbrit.co.uk
or contact the Society concerned

Other underground-related events

- 11 May, 8 June, 13 July, 10 August, 14 September
Reigate Caves open days, in association with Wealden
Cave and Mine Society (WCMS)
www.wcms.org.uk/pages/club/reigate_caves.shtml
1 June Fortress Study Group study day Fort Horsted

- 22 - 23 June, 27 - 28 July, 24 - 25 August,
28 - 29 September Cuckfield ROC post open days
www.subbrit.org.uk/rsg/roc/db/988303920.008001.html
www.rocremembered.com/cuckfield/cuckfield
28 June to 1 July NAMHO conference and visits,
Aberystwyth www.namhoconference.org.uk
Sat 13 - Sun 28 July Festival of British Archaeology
(CBA) www.festival.britarch.ac.uk
6 - 9 September Fortress Study Group
Annual Conference and AGM
12 - 15 September Heritage Open Days
www.heritageopendays.org.uk
21 - 22 September London Open House
www.londonopenhouse.org.uk
14 September to 27 October Poster Art 150
London Underground's Greatest Designs at London
Transport Museum www.ltmuseum.co.uk
September Doors Open Days, Wales
www.opendoorsdays.org.uk
September 1, 7 - 8, 14 - 15, 21 - 22, 28 - 29
Doors Open Days, Scotland www.doorsopendays.org.uk

Subterranea Britannica Autumn Meeting 2013

Saturday 19 October, commencing at 10.00am

Royal School of Mines, London SW7 2BP

There will be the usual mix of interesting illustrated talks, including

Laurent Triolet on shelters and war tunnels in France, Cappadocia,
Afghanistan, Vietnam and Lebanon

Les Riley on North Lincolnshire Ironstone Mining

Robin Hill on the Frome Tunnels project

Mike Chrimes on London Underground: Civil Engineers & the Tube: 1863 to 1948
along with Members' contributions and a chance to
meet and mingle with fellow enthusiasts

A paper Booking Form is enclosed with this issue of *Subterranea*

The programme & booking form will also be on the website.

Please put the date in your diary now!



Notes of SB Committee Meeting – 26 January 2013

Chairman

Martin Dixon reported that the Annual Return had been filed at Companies House, and that a Trustees' Report for the Charity Commission had been prepared. He also reported on the progress that had been made with improving links with other bodies, and that the trip to Gothenburg in May had been largely finalised. Opportunities to work with local councils to produce signage for certain sites were being explored.

Finance

The committee confirmed a previous decision that retrospective Gift Aid money should be "ring fenced" for projects/good causes, but agreed that annual receipts could be used for public benefit on items such as web fees and day meetings. The Treasurer reported that income for 2012 had not covered operating expenses, and further increases on costs such as postage would exacerbate this situation. Although the committee would continue to explore opportunities to limit expenditure, the committee agreed to recommend at the AGM an increase in subscriptions to take effect in 2014. UK membership would rise from £19 to £21, and overseas membership from £28 to £31. The only request for Gift Aid Funding that had been received was for the Cuckfield ROC post, and the committee agreed to a donation of £548. It was agreed that funding would be available to help the cost of scanning and access to the Subterranea Britannica collection.

AGM

All existing committee members confirmed that they were willing to stand for re-election at the AGM, and Richard West (currently co-opted) also confirmed that he was willing to become a committee member. All paperwork relating to the AGM – agenda, nomination form, etc – would be available on the Sub Brit website in early March, with printed copies being sent to those who had requested them. The closing date for nominations to the committee would be 1 April 2013.

WebSite

Richard Seabrook reported on the continued success of the social media sites, all of which had recorded an increase in numbers. The website itself had served 146,117 unique visits to over 2.29 million pages between September and December, an increase over the same period last year. The committee discussed ways in which improvements to the website could be implemented, possibly using alternative software. The Subterranea Britannica shop had proved extremely successful, and represented a new source of income for the society. Thanks to Richard for his hard work on this.

Meetings & Visits

Visits in the pipeline are to Holmpton, Portland, Fort Widley & Fort Purbrook, Colehouse Fort & Fort Southwick. Other locations were under consideration, and the committee agreed that this should be a priority in the coming year. The Liverpool weekend had been a great success thanks, especially, to the help received from the Friends of Williamson's Tunnels. The annual UK study weekend is being researched, for Devon in September. The Gothenburg weekend is well subscribed for May.

Subterranea

Nick Catford reported that *Subterranea* 31 had been a bumper issue because of the number of articles that needed to be included, and had been very well received by members. He said that the current editorial and production team was working very effectively, but the committee agreed that potential savings on printing costs should be explored.

Membership

Nick Catford reported that membership had remained steady at about 1,100. He said that the majority of members were now using PayPal, but that cheques and bank transfers would continue to be accepted methods of payment. The next committee meeting will be held on 15 June 2013; any members wishing to raise any matter should do so in writing to the Secretary at least two weeks before.

Roger Starling, Secretary

We are sorry to announce the death of Richard Sheard, a very early member of Sub. Brit. It was his mother-in-law Kay de Brisay who initially brought him to our group because he and his wife chauffeured Kay to our Cambridge meetings. Kay was an archaeologist in Colchester working on the Roman salt industry. Once Richard started to attend our Day Conference meetings

at Lucy Cavendish College he became fascinated with our varied studies and became a staunch member himself. In recent years Richard's activity has been largely limited to reading our publications and it is pleasing to know that his wife Jacqueline, to whom we extend our deep sympathy - plans to continue with Sub Brit membership as she too has been bitten by the bug.

Sylvia Beamon

NEWS – ARCHAEOLOGY

Archaeologists to reopen what might be the world's oldest surviving railway tunnel, Derbyshire

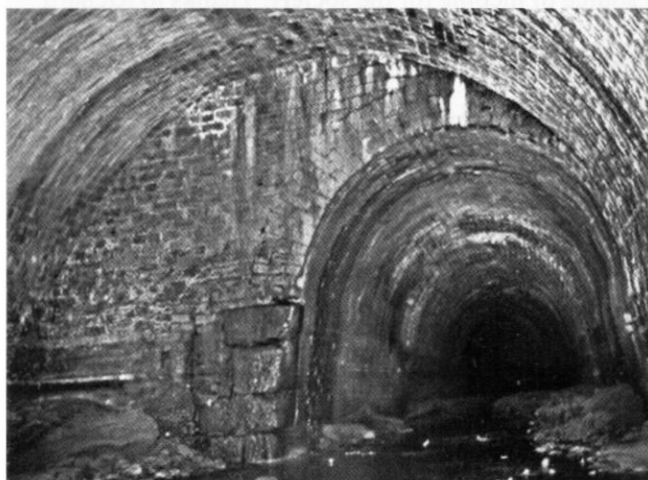
The Derbyshire Archaeological Society has received £17,900 from the Heritage Lottery Fund to investigate the 1793 'Butterley Gangroad', the oldest (horse-operated) railway of which substantial remains survive. A particular focus of the investigation is to be the railway's tunnel under a road at Fritchley – possibly the world's oldest railway tunnel. The tunnel is to be reopened and recorded. The railway conveyed limestone from quarries at Crich to the Cromford Canal at Bull Bridge, where the stone was forwarded by boat to a further tunnel below the Butterley Company's works, at which point the stone was lifted into the works,

SOURCE: Derbyshire Archaeological Society, 2013, Butterley gang road. *Industrial Archaeology News*, 164, page 19.

English Heritage protects a stretch of Butterley Canal tunnel

Part of Cromford Canal's Butterley Tunnel in Derbyshire has been designated as a Scheduled Ancient Monument. English Heritage has protected a stretch of 700ft directly beneath the former Butterley Works.

The section includes a unique system where boats used to be loaded and unloaded by vertical hoists directly into the works above. This system – which does not exist anywhere else in the world – dates back to the construction of the canal in 1790.



Pat Morriss, chair of the Friends of Cromford Canal, said she was delighted with the news. She said: "This is fantastic and very welcome. The Butterley site has long and historically significant connections with the Cromford Canal.

"English Heritage's decision vindicates our long-running campaign to protect this fascinating remnant of Britain's industrial past, forming a transport lover's cluster with the nearby Butterley site of the Midland Railway, Crich Tramway Village, Peak Rail at Matlock and the Derwent Valley Mills World Heritage Site of which the Cromford Canal plays a significant part."

SOURCE: *Derbyshire Times*, 2 March 2013

Ice Age art exhibition at the British Museum, London

The opening of an exhibition of Ice Age art at the British Museum was announced in the February issue of *British Archaeology*. Objects displayed, a number of them from once-inhabited caves, include representations of human figures, and drawings engraved on bone.

SOURCE: COOK, Jill, 2013, Ice Age art: meeting the modern mind. *British Archaeology* 129, 26–29.

Tunnel at Bilston Glen, near Edinburgh

A tunnel of unknown purpose has been investigated at Bilston Glen, about five and a half miles south of Edinburgh. Reported exploration and digging through roof-falls has to date revealed 75 metres of tunnel followed, by a turn to the left, of another two metres. At one point what may be the bottom of a back-filled shaft was noted, as was the sound of running water below and beyond the furthest point reached. Precautions were taken to monitor air quality during the exploration. No suggestions are presented concerning the tunnel's purpose.

SOURCE: PETTIGLIO, Derek, 2012, Meet note: Bilston Glen tunnel. *Bull. Grampian Speleological Group*, 4th Series, 5(3), page 5.

Possible Iron Age rock-cut 'cave' near North Berwick, East Lothian

Alan Jeffreys has reported on a small apparently man-made 'cave' about three miles east of North Berwick, first reported in 1832 by one George Sligo. The 'cave' has been excavated into trachytic agglomerate overlying Old Red Sandstone at NGR NT 604845. Trachytic agglomerate is consolidated explosion breccia composed of irregular pieces of trachyte lava. The 'cave' entrance is eight metres above the beach and is about nine metres long to the back wall. Fragments of an irregularly paved floor, Iron Age pottery, and horse bones are reported.

SOURCE: JEFFREYS, Alan, 2012, Seacliffe Cave, Auldham, East Lothian. *Bull. Grampian Speleological Group*, 4th Series, 5(3), 19–22.

Cat leads the way to an unknown catacomb, Rome, Italy

A man chasing a stray cat off his property in Rome has stumbled into an unrecorded catacomb containing 2,000-year-old human bones. The entrance was found at the base of a 'low tufa rock cliff' near the Via di Pietralata. The cat disappeared into a hole, and Mirko Curti and his friend followed. Archaeologists have concluded that the site dates from between the first century BC and the second century AD. Niches to store jars of human ashes were also noted. The uncremated bones might, it is supposed, have fallen in from a separate catacomb higher up inside the cliff.

Burying one's dead relatives in rock-cut tunnel systems has, from time to time, been popular in various places, including Rome and Sicily (Italy), and Kiev (Ukraine). Tunnels with purpose-built burial niches are even to be

found (though it seems they were never tenanted) at the cemetery alongside the Mansfield Road in Nottingham (visited by Subterranea Britannica during a Study Weekend some years ago). The famous Paris ‘catacombs’ however are not strictly speaking catacombs at all. They are disused subterranean building-stone quarries utilised for stockpiling bones when cemeteries around the then perimeter of the city were cleared to allow for municipal expansion. They should really be referred to as ossuaries.

SOURCE: KINGTON, Tom, 2013, A cat, a tomb – another Roman catacomb. *The Guardian*, 19 October 2012, page 33.

NEWS – HEALTH & SAFETY

Man dies as his bedroom collapses into a sink hole in Florida

A Florida man screamed for help and disappeared as a large sinkhole opened under his bedroom on 28 February 2013.

The sinkhole, estimated at 20 feet across and 20 feet deep, caused the home’s concrete floor to cave in as everyone in the Tampa-area house was turning in for the night. It gave way with a loud crash that sounded like a car hitting the house and brought Bush’s brother running. Jeremy Bush said he jumped into the hole but couldn’t see his brother and had to be rescued himself by a sheriff’s deputy who reached out and pulled him to safety as the ground crumbled around him.

“The floor was still giving in and the dirt was still going down, but I didn’t care. I wanted to save my brother,” Jeremy Bush said in a neighbour’s yard. “But I just couldn’t do nothing although I could swear I heard him hollering my name to help him.”

Officials lowered equipment into the sinkhole and saw no signs of life. A dresser and the TV set had vanished down the hole, along with most of Bush’s bed. County administrator Mike Merrill described the home as “seriously unstable”. He said no one can go in the home because officials were afraid of another collapse and losing more lives. The soil around the home was very soft and the sinkhole was expected to grow.

Engineers said they may have to demolish the house, even though from the outside there appeared to be nothing wrong with the four-bedroom, concrete-wall structure, built in 1974.

Florida is highly prone to sinkholes because there are caverns below ground of limestone, a porous rock that easily dissolves in water. A sinkhole near Orlando grew to 400 feet across in 1981 and claimed five sports cars, most of two businesses, a three-bedroom house and the deep end of an Olympic-size swimming pool. More than 500 sinkholes have been reported in Hillsborough County alone since the government started keeping track in 1954, according to the state’s environmental agency.

SOURCE: *Sky News*, 2 March 2013

Drilling rig falls down Cumbrian mine shaft

On 5 November 2012 the top of a shaft at the Gillfoot iron ore mine opened up behind a row of eight houses in Egremont, Cumbria. A drilling rig was on site capping what was reputed to be an 80-ft mine shaft after reports of land slippage. However a 75ft diameter crater suddenly opened up, causing the drilling rig to fall into the mine.



Unfortunately the only worker on the rig at the time had his safety line clipped to it and he was pulled down the hole. Luckily he was rescued by one of the nearby householders who witnessed the incident from his kitchen window.

SOURCE: Shropshire Caving and Mining Club newsletter, December 2012

Unmanned runaway maintenance train hurtles through seven stations on the London Underground

London Underground and its contractors have been fined a total of £300,000 after an engineering train ran out of control for over four miles on the Northern Line. The 39-tonne runaway train reached speeds of up to 30mph as it hurtled southbound on the line for 16 minutes, creating the potential for a “terrible tragedy”.

Tube Lines Limited and Schwebbau GmbH were also fined and the trio were ordered to pay costs of £44,074 following the prosecution brought by the Office of Rail Regulation (ORR) for breaches of health and safety law. All three companies pleaded guilty to charges, with Schwebbau GmbH also pleading guilty to an additional charge under Section 2 of the Health and Safety at Work Act.

Shortly before 07:00 hrs on Friday 13 August 2010, an engineering train ran away along part of the Northern line of London Underground. The train consisted of a self-propelled diesel-powered unit designed for reprofiling worn rails. It had been working between Highgate and Archway stations on the southbound line during the night of 12/13 August. At the end of grinding operations that night, the crew of the unit found that they were unable to restart its engine to travel away from the site of work.

An assisting train, consisting of a six-car train of the 1995 stock used on the Northern line, was sent to the rescue

of the grinding unit. The assisting train was coupled to the grinding unit by means of an emergency coupling device, and the braking system of the grinding unit was de-activated to allow it to be towed. The combined trains then set out to run to East Finchley station.

At about 06:42 hrs, after passing through Highgate station, the coupling device fractured and the grinding unit began to run back down the gradient towards central London. The crew of the grinding unit, who had no means of re-applying the brake, jumped off the unit as it passed through Highgate station. It then ran unattended for about four miles, passing through a further six stations, and came to rest near Warren Street station about sixteen minutes later. LUL control room staff took action to clear trains away from the path of the runaway unit.



The grinding unit runs through Highgate station

No one was hurt. There was some damage to the grinding unit, and points at Mornington Crescent station were damaged when the unit ran through them. The emergency coupling broke because it was not strong enough for the duties it was intended to perform, and had been inadequately designed and procured. The Rail Accident Investigation Branch has made seven recommendations to London Underground Ltd, covering the processes for introducing new engineering equipment, review of existing equipment, investigation of incidents, training of staff, the operation of unbraked vehicles, and the quality assurance processes used by LUL and its associated companies.

Judge Richard Hone at the Old Bailey said: “There was the potential of terrible tragedy. To those involved it must have seemed an extremely frightening eternity.”

The charges result from the companies’ failure to effectively coordinate, plan and work together in transporting the damaged train, as procedures were not followed, a press release from the ORR stated. It also emerged previous failings made during a rescue of the same train had occurred less than one month earlier on 17 July 2010.

Following sentencing, Ian Prosser, ORR’s Director of Safety, said: “This is clearly unacceptable, and led to a potentially catastrophic incident on the Northern line where the train careered out of control for over four miles. It was only the professionalism of control room staff taking decisive action which prevented a collision between trains, and averted a much more serious outcome. We welcome the steps taken by the companies

to improve safety management on London Underground since this incident.”

SOURCE: *Huffington Post*, 1 March 2013 and Department of Transport report, 13 August 2010

Caver killed by falling car, Ukraine

In a freak accident, one caver was killed and two others injured after their car fell into the cave they were descending.

About 5:00 pm on 9 January, Crimea Mountain Rescue were called to an accident involving five cavers and a car at Monastery Chokrack Cave in Ukraine’s Karabi Yayla massif.

It seems that a group of five cavers (three men and two women) were descending the 80-metre (262-foot) deep vertical entrance pitch of the cave. Two of the men had reached the bottom, while a 26-year-old woman had descended about 60–65 metres. The team leader had reached a depth of 20 metres with a 20-year-old woman at about 10 metres (33 feet) down, when for some unknown reason, their vehicle fell into the cave.

The falling vehicle appears to have broken the main rope, causing the team leader and 26-year-old woman to fall to the bottom of the pitch. Although injured by the falling vehicle the 20-year-old managed to climb to the surface and raise the alarm. At the surface the cave entrance is only four metres across, but luckily it gets wider and the two cavers at the bottom were not hit by the falling vehicle.

Due to the mountainous terrain it took rescuers several hours to reach the site. Just after 9:00 pm rescuers along with a doctor were able to descend the cave. They reported that the team leader had not survived the fall, while the woman who fell 15 to 20 metres was in a serious condition. In addition the rescuers were concerned about the danger of fire from the fuel that had leaked all over the cave from the damaged vehicle.

The two uninjured men were brought to the surface, followed just after midnight by the injured woman who was then taken to hospital by ambulance with serious injuries to her pelvis and shoulder. An investigation into the incident is now under way.

SOURCE: *Below*, Shropshire Cave and Mining Club Journal, Spring 2013

NEWS – CONSERVATION AND HERITAGE

Lea Bailey Light Railway and mine, near Mitcheldean, Gloucestershire

The Lea Bailey mine in the Forest of Dean was opened by the Chastan Syndicate in 1906, and had an associated two-foot-gauge rail line running into the level below the Wigpool iron mine, extending to 580 yards in from the entrance. A small group of volunteers is working to rebuild the railway. The mine level is kept locked unless a working party is on site. Visitors, and more volunteers, are welcomed.

Contact Rob Needham (email: Robert.needham@live.co.uk), Pike House, George Lane, Littledean, Gloucestershire GL14 3LL for more information or to visit.

NEWS – MILITARY AND DEFENCE

Battle of Britain Ops Room to open to the public, RAF Uxbridge

One of Britain's most historically significant sites is to open to the public following an overwhelming response from local people.

More than 3,000 people turned out to a trial open weekend at the Battle of Britain operations room at RAF Uxbridge last year, and now the RAF has decided to take it to the next level.

The bunker, off St Andrew's Road, Uxbridge, will open its doors every Saturday and Sunday from 10am to 4pm from March 23, for three months.



Plotting room in the bunker. Photo Nick Catford

Its original operations room and accompanying museum will be available for visitors to look around at their leisure, just as Winston Churchill did on several occasions during the Second World War. Previously admission was by appointment only, meaning many local people had never been inside the national treasure. As word spreads, the bunker is likely to draw visitors from far and wide.

SOURCE: *Uxbridge Gazette*, 6 March 2013

Uxbridge AAOR Demolished

During WWII the anti-aircraft guns surrounding the capital were controlled from a series of gun operations rooms built into a lift shaft at the closed Brompton Road tube station. During the early years of the Cold War, Brompton Road was intended to be hardened for further use as an anti-aircraft operations room (AAOR) but was considered unsuitable. It was to be replaced by three new bunkers constructed from 1951 onwards and completed in 1953. Lippitts Hill in Essex on the south side of Epping Forest covered the London North GDA (gun-defended area) and Merstham in Surrey controlled

the London South anti-aircraft zone. The third bunker for controlling the West London GDA was sited within the RAF Uxbridge complex. Brompton Road was retained as a backup AAOR although in reality although completed in 1953, there is no evidence that any of the London AAORs were ever brought into use. An exercise is known to have taken place at Brompton Road in May 1955.



Demolition is underway in mid-November 2012.

Photo Paul Francis

With the demise of AA Command in 1956, the three new control centres were themselves redundant when guided missiles replaced gun defence. The two-storey semi-sunken building at Uxbridge was of the standard AAOR design put to a number of different uses, the most recent being in 1969 when the bunker became a communications centre for the USAF as part of their Autovon network. At this time the bunker was considerably altered internally, including the flooring-over of the original well. The Americans required their own independent power supply so a new building was constructed adjacent to the bunker to house two diesel generators.

In 1996 the bunker was no longer required and was placed on care and maintenance until RAF Uxbridge closed on 31 March 2010 as part of the Ministry of Defence's Project MoDEL, a programme to reduce the number of defence sites in Greater London in favour of a core site at RAF Northolt. In April 2012, VSM Estates announced it would be completing the purchase of the site from the MoD, with a view to commencing building work by the end of the year. As part of the ongoing redevelopment of the site the bunker was demolished in November 2012.

SOURCE: Sub Brit web site and Airfield Information Exchange

RAF Neatishead offered for sale on eBay

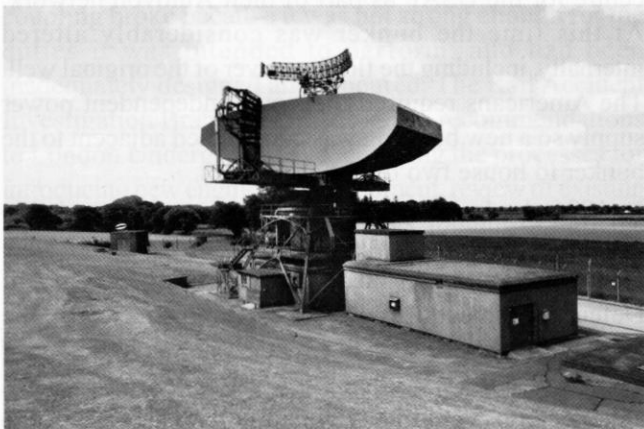
The Neatishead airbase in Norfolk opened in June 1941 and played a key role in monitoring Britain's skies in the 1960s as a radar station until it was decommissioned in 2006. It contains an underground ROTOR bunker from the Cold War years, which is one of the 16 buildings included on the 25 acres that were up for sale on the eBay online auction site.

Birmingham-based Stylespace bought the land from the RAF in 2006 for £4m. The RAF still carries out communications work for aircraft on a small part of the site. This would remain, alongside the RAF Air Defence Radar Museum, which was established on the air base fourteen years ago and bought by trustees off the RAF last year.

Agent Nick Barlow, from Midlands-based Barlow Associates, said: “The owner thought that the underground bunker would work for him as a data centre but to cut a long story short it didn’t work for him. Neatishead has been on the market for a long while and one is always open to try new ways of selling things. It was put on eBay to increase its publicity and make it more obvious to a wider market.

“There is only so much you can do on ‘for sale’ boards and in newspapers. It is a heck of a lot of buildings for the price and it is a matter of finding the right person to take it on.” He said the site has been on the market for more than two years and that the price had been reduced “substantially”.

Mr Barlow added he was confident the former base would sell and there has been a lot of interest in the site in the past, but issues including the recession have prevented it from being sold. He said that since Neatishead had gone on eBay there had been a lot of interest. “The owner would split the site provided they were substantial chunks because it would be a good move for local businesses and jobs,” Mr Barlow added.



The Type 84 radar has been listed as a Scheduled Monument by English Heritage. Photo Nick Catford

The site comes with planning permission for 3.5ha of solar panels, approved by North Norfolk District Council in May 2011. [The final day for bids was Friday 8 February and at the end of the auction none had been received!]

SOURCE: *EDP24 News*, 1 February 2013

The Queen’s WWII bunker

In 1940 and 1941, when the risk of invasion was very real, members of the Royal Family were living very simply in Appleton House, a Sandringham Estate property that boasted a large concrete bunker, specially built for their safety. Appleton House was demolished in the 1970s.

SOURCE: *Eastern Daily Press* 11 March 2013

Joint Services School for linguists at Coulsdon Common, LB Croydon

A bit of Cold War history with no subterranean dimension has been published by the local history society for much of east Surrey and the southern part of the London Borough of Croydon. A hutted encampment near *The Fox* public house on Coulsdon Common was built for and occupied by the Joint Services School for Linguists, which body taught service personnel Russian. This is a detailed and well illustrated account of a somewhat shadowy services establishment in the Home Counties. SOURCE: MILLS, Dennis R., 2013, The training of linguists for war, Coulsdon, 1952–54. Part I: learning Russian. *Bourne Society Local History Record* 73, 3–13; MILLS, Dennis R., 2013, The training of linguists for war, Coulsdon, 1952–54. Part II: outside the classroom. *Bourne Society Local History Record* 74, 3–14.

Opticians in bid to save Mickey Davis’s wartime Spitalfields air-raid shelter

Opticians have joined other professions in the debate over the future of the historic London Fruit & Wool Exchange now facing the bulldozers in London’s East End.

A ‘people’s hero’ of the wartime Blitz who ran one of London’s biggest public air-raid shelters in the reinforced basement of the Exchange is being featured in *The Optician* trade journal.

Optometrist David Baker has researched the story of Mickey Davis, a 3ft 3ins midget who ran the shelter for up to 5,000 people a night, one of the few safe havens for the East End’s working class during the nightly Luftwaffe air raids in 1940.

“Mickey’s shelter still survives – but perhaps not for long,” Baker warns. “The Fruit Exchange where it was housed is due for redevelopment, despite the existence of wartime artefacts in the basement.”



Mickey Davis and his wife Doris in the shelter Mickey Davis himself was an optician who was bombed out of his East End premises in the air raids and spent his

time instead organising the shelter. His fame spread and even American war correspondents wrote about “the midget with a giant heart”. Mickey persuaded companies like Marks & Spencer to donate food to run a shelter canteen, the profits of which were used for free milk for children – the forerunner of the postwar welfare state. But the story doesn’t end there. London Mayor Boris Johnson overruled Tower Hamlets Council’s decision last October to allow the Fruit Exchange to be demolished, despite a campaign led by TV historian Dan Cruickshank. English Heritage is now actively considering listing the art deco building in Brushfield Street, Spitalfields.

Mickey went on to be elected a Stepney borough councillor in 1949 and rose to be Deputy Mayor before he died in 1956 aged 49, during an operation to correct a spine defect from birth.

SOURCE: *Docklands & East London Advertiser*, 5 February 2013

Explosion at Fordow nuclear site in Iran

In early January speculation arose regarding a reported explosion at Iran’s Fordow nuclear site. It was reported by an Iranian defector that an explosion at Fordow, one of Iran’s most secret nuclear sites, had destroyed half the installation and trapped around 240 personnel underground. Reports are still unconfirmed.

The site has become a centre for Iran’s nuclear activity due to the 2,700 centrifuges enriching uranium to the 20 percent level. A further enrichment to weapons grade would take only weeks, experts say.

According to a source in the security forces protecting Fordow, an explosion on Monday at 11:30 am Tehran time rocked the site, which is buried deep under a mountain and immune not only to air strikes but to most bunker-buster bombs. The report of the blast came via Hamidreza Zakeri, formerly with the Islamic regime’s Ministry of Intelligence and National Security.

Iran’s security services are reported to have shut down an area of around 15 miles in radius around the site. A day after the explosion, President Mahmoud Ahmadinejad apparently convened an urgent meeting with senior intelligence and security officials to discuss the blast, the report said.

SOURCE: *The Commentator*, 27 January 2013

Plan to convert Mistley AAOR, Essex, into maisonettes is rejected

Reliant Building Contractors Ltd submitted proposals to turn the Grade II-listed Mistley site into three four-bed maisonettes.

The bunker, located in Shrubland Road, was constructed in 1951 as part of the anti-aircraft defence network built to protect the country from nuclear attack.

The application also sought to build 28 properties including flats and terraced houses in the grounds as an enabling development to help fund the conversion of the bunker. Members of Tendring District Council’s planning

committee voted against the application at a meeting on Tuesday despite its being recommended for approval by officers.

Cabinet member for planning Carlo Guglielmi said: “The main issue is there were too many dwellings proposed – 31 is a huge amount for the area. The access through the site is abysmal and given the location there’s no way to improve access, so with sixty cars a day coming in and out, that’s an intense amount of traffic.

“I would invite the developers to come back with a scheme which is more in keeping with the area and is in line with the emerging local plan – maybe two or three larger aspirational houses, for example.”



The operations room at Mistley when it was open as a museum. Photo Nick Catford

The two-storey reinforced concrete bunker became obsolete in 1956 after the Anti-Aircraft Command was abolished, and in 1963 was acquired by Essex County Council. The bunker was decommissioned in 1993 and opened as a museum between 1996 and 2002. Since then it has not been used.

The bunker, which was Grade II listed in 2007, is considered to be one of the best preserved examples of its type in England.

SOURCE: *EADT 24*, 31 January 2013

Mixed fortunes for half a million Cold War concrete bunkers, Albania

Before the fall of the communist government in Albania, the regime (with assistance from China and North Korea) littered the country with around half a million concrete bunkers.

Attack was feared from the west, as well as from the former Soviet Union and the former Yugoslavia. There is a debate about whether all these reminders of an unloved past should be destroyed, put to some alternative use, or cherished as undeniable mementos of the country’s heritage.

In the absence of an overall plan, the structures are disappearing or being put to other uses anyway. Many



One of many bunkers in an urban setting.
Photo David Galjaard

are being blown up, often with home-made explosives, for the sake of the scrap value of the steel reinforcing bars. Some are being put to use as 'no-frills' hostels for budget tourists. One has even become a tattoo parlour. SOURCE: GEOGHEGAN, Peter, 2012, From bunkers to bunkbeds: Albania reuses its cold war relics. *The Guardian*, 27 September 2012, page 30.

Deep level air-raid shelter in Epsom, Surrey, to become gold vault

Hundreds of millions of pounds worth of gold and other precious metals could be stored in chalk tunnels built to protect north Surrey people from the Blitz. Planning permission has been granted to turn 2,000 square metres of tunnels off Ashley Road in Epsom into a vault for precious metals.

The plan is the brainchild of Dr Willem Frischmann CBE, a distinguished engineer who received planning permission from Epsom Council in August 2012 for the conversion.



One of the two long parallel tunnels in the Ashley Road shelter. Photo Nick Catford

With insurers setting a limit to the amount of gold they will insure at any one location, and with the price of gold soaring, banks around the world are under pressure to find new locations to store bullion. London is the centre

of the bullion market and only last year Barclays announced that it was opening a new gold vault there. The tunnels, which run 50 feet deep through chalk, were built at the start of World War II to shelter more than 2,000 people from German bombs. But they were rarely used and are now only home to bats as well as being used twice a week by Elite Action Games for airsoft wargames.

Dr Frischmann is a holocaust survivor, who helped design Centre Point in central London. He bought the air-raid shelter site at an auction about ten years ago convinced it was a great place to store valuable objects. He said: "If it is possible for people to live there when it is bombed, it will be a good place to have precious metals."

He said talks were taking place with a number of banks interested in using the site. The plans for a storage facility include existing toilets being converted into a store as well as the creation of an extension at the front for offices with an access ramp to the vault below.

A portion of the existing tunnel network and toilet zone would be reserved for bats after a survey in March found evidence of Natterer's bats, a fairly common species found throughout much of the UK.

SOURCE: *Epsom Guardian*, 17 January 2013

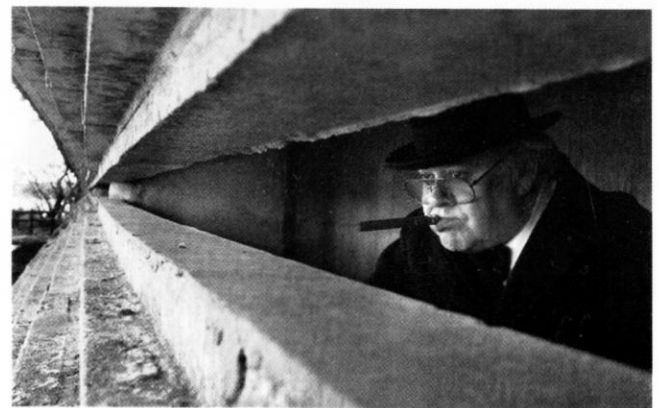
D-Day bunker overlooking Studland Bay, Dorset, listed by English Heritage

The British Prime Minister was joined by Dwight D. Eisenhower, the Supreme Allied Commander, and King George VI at the observation point on the eve of the invasion of Europe.

But Fort Henry, which overlooks Studland Bay in Dorset, is now looked after by the National Trust and has been given a Grade II listing in recognition of its historical significance.

Nearby Second World War beach defences including gun emplacements, pillboxes, and concrete anti-tank 'pimples' have also been listed for protection.

It is the first time the fort has been listed for its historical importance. English Heritage listed the building because of its historical associations, design and good state of preservation.



In the run-up to D-Day in 1944, Studland Bay was the scene of the largest live ammunition practice of the entire

war. Thousands of troops took part in Exercise Smash, a full-scale rehearsal for the invasion of occupied Europe. The bay was considered a possible target for a German invasion and was heavily fortified from 1940 onwards. In April 1944 the fort was used by King George VI, Churchill and Eisenhower along with General Bernard Montgomery and Admiral Louis Mountbatten to watch the exercise.

The group watched a demonstration of carpet bombing followed by an assault landing by troops. The use of live ammunition in a rehearsal run was not regular practice, but military leaders wanted it to be as realistic as possible for the soldiers.

Built in 1943, the fort was a specially constructed concrete bunker and observation post. It was 90 feet long with walls, floor and ceiling all three feet thick, and was considered a safe place for the group to witness the rehearsal of the Normandy landings. Visitors can now go inside the bunker and look through the same observation slit the men used to view the training exercise.

The fort was built by Canadian Royal Engineers, who named it after their home base in Ontario.

SOURCE: *Daily Telegraph*, 5 December 2012

Hidden bunker discovered in school field in Stockton-on-Tees

Teachers at Teesside High School in Stockton who discovered they had a long-lost Second World War air-raid shelter under their school field have been shocked to be handed a map detailing five more shelters dotted around the school grounds.

The known air-raid centre was first discovered at the private Teesside High School in Eaglescliffe, Stockton, two years ago when a tree fell down in stormy weather. School managers are applying for funding to turn the first shelter into a “living history project”, complete with seating and lighting, where heritage weekends and history projects could be held.

The shelters were almost certainly built by ICI who commandeered the site shortly after the outbreak of the Second World War in 1939.

SOURCE: *Northern Echo*, 7 February 2013

NEWS – MINING AND QUARRYING

Mine-shaft restaurant takes dining to a new low, Finland

In a bid to turn the idea of pop-up restaurants on its head, an award-winning Finnish chef has opened a unique eatery in an old mine shaft, 80 metres underground. It’s called a ‘pop-down’ restaurant.

“‘Pop-down’ is such a unique idea that I just had to do it,” chef Timo Linnamaki stated, before his first clients descended to the bottom of the mine shaft in the town of Lohja, Finland. “It’s great working down here because you are totally cut off from the world, so nothing distracts from the cooking.”



The idea of preparing food so far below ground was all part of being close to the earth, but the talented cook admits this is by far the weirdest place he has ever prepared his dishes and that it would be very difficult to find something on par. The 115-year-old mine chosen as the location for this unique pop-down restaurant goes down to a depth of 380 metres, where limestone is still mined for the chemical industry. But that didn’t seem to scare off customers, as the 64-seat restaurant is already fully booked until the end of September 2012 when the underground cooking experiment will end.

SOURCE: www.odditycentral.com, 12 September 2012

Visit to a lead mine in the Ogwen Valley, North Wales

A description of a recent visit into an unidentified lead mine near a climbing club cottage at Glen Dana in the Ogwen Valley has been published.

The underground features and their attendant hazards including false floors, precipitous drops, and hundreds of tons of loose rock supported overhead on now-rotten timber, are all graphically described. Novice would-be mine explorers are strongly advised to read accounts such as this before venturing underground. And it cannot be emphasised too strongly that it is all but essential to liaise with persons who are familiar with what is to be found underground, and to liaise with (preferably as a paid-up member with third party insurance cover) a properly constituted mining exploration society. Bear in mind, also, that old mine entrances may well be the subjects of mine access agreements between such societies and the land-owners and / or occupiers. By-passing access agreements could lead to entrances being permanently sealed and access denied to everybody in future.

SOURCE: FRANCE, Stuart, 2012, Snowdonia mines. *Nl. Chelsea Speleological Soc.* 54(11), page 107.

Zinc mine to open in Cumbria

Minco Plc has been drilling exploratory boreholes for zinc ore bodies in the Melmerby Scar Limestone north of Nenthead between Ramp Gill Vein and Brownley Hill Vein. The company is looking to drill a maximum of eight holes between 350 and 600 metres deep.

Assuming economic deposits are discovered it will probably be about five years before the mine reaches



NEWS — MISCELLANEOUS

the development stage. It is estimated that the price of zinc is likely to rise in the next few years due to a shortage of the metal.

SOURCE: *Below*, Shropshire Cave and Mining Club Journal, Spring 2013

Last UK clay mine to close, Yorkshire

Shibden Farm No.2 Mine near Halifax, Britain's last clay mine, has finally closed. The mine produced high-grade Halifax Hard Bed Clay for Parkinson-Spencer Refractories Ltd (a private limited company owned and controlled by the Parkinson family), making a variety of products for the glass industry.



Shibden Farm mine in 1980. Photo Kevin Lane

Due to the refractoriness of the clay (i.e. its ability to withstand high temperature), one of its main uses was for 'Glass pots' – for holding molten glass for glass blowers. Two men worked about one day per week getting the clay out manually; it was pushed out in small trucks with 'penny wheels' on flanged rails.

SOURCE: *Below*, Shropshire Cave and Mining Club Journal, Spring 2013

Northern Mine Research Society

Fellow NAMHO member, the Northern Mine Research Society offers back-issues of its journal *British Mining* for sale, at from £8 to £12 each (postage and packing £2 extra on each).

NMRS is amongst the leading mining history societies in the UK, with a membership and range of interests extending far beyond the limits of Durham and Yorkshire. *British Mining* is a well-produced and highly respected journal. Forty or so issues are available, dated 1986 to 2012.

Although papers on lead tend to predominate, there are papers and whole issues devoted to other mined resources including chert, coal, stone, and so forth. Details can be found on the website www.nmrs.org.uk and orders placed with Barbara Sutcliffe, NMRS, The Old Manse, 93 Halifax Road, Nelson, Lancashire BB9 0FQ / email mansemins@btopenworld.com / tel: 01282 614615. NMRS also organises, of course, a range of indoor, outdoor, and underground meetings, and welcomes new members.

London Underground 150th anniversary commemorative stamps

The Royal Mail issued a number of LU 150th anniversary stamps in January 2013, as the first trains ran on the first part of the world's first underground railway system in 1863. There are six designs, of which the lowest values (for standard second-class letters) are arguably the most appealing to Subterranea Britannica members.

2nd class (50 pence) shows a steam-hauled Metropolitan Railway train in tunnel in 1863

2nd class (50 pence) shows men at work on a tunnelling shield in 1898

1st class (60 pence) shows commuters in a London Underground train carriage in 1911 (commendably, none of them is smoking, although there are no NO SMOKING signs in view!)

1st class (60 pence) shows the art deco surface station building at Boston Manor in 1934

£ 1.28 (the stamp required for a 21 to 40g letter to mainland Europe) shows 'classic rolling stock' (a red tube train) in 1938

£ 1.28 shows Jubilee Line escalators at Canary Wharf in 1999

Two commemorative £ 2 coins have also been issued.

Very few postage stamps with any sort of underground theme have been issued in the UK. On 3 May 1994 a set of four stamps was issued (two 25p stamps and two for 41p) to mark the opening of the Channel Tunnel, although the design themes were Anglo-French unity rather than celebrating a civil engineering triumph (similar stamps were also issued by France).

Earlier, on 28 April 1976, one of a set of four stamps commemorating British social reformers was issued (with a face value of 8½ p) featuring the digging of a very thin coal seam: this was to commemorate Thomas Hepburn [1796–1864], whose extensive entry in the *Oxford Dictionary of National Biography* describes him as a miners' leader and pioneer of trade unionism, born in February 1796 in the Durham pit village of Pelton.



DIY fanatic built an underground cannabis factory beneath his patio in Salford

A DIY fanatic who joked he had a 'secret garden' had built a 12ft cannabis factory underneath his patio. Neighbours were completely unaware that David Mundy, 54, had secretly burrowed into land next to his home and built the underground factory to grow marijuana plants. The residents of Barr Hill Avenue, Salford, even said he joked about the 'secret garden' when asked about the amount of DIY work he was carrying out. Police only discovered the underground factory following a tip-off, with a secret entrance that could only be accessed by a set of hidden ladders. Officers found 17 plants growing in the underground 12ft-square lair with a street value of more than £8,000.



The entrance to the underground factory

There was a sophisticated hydroponic irrigation system complete with extraction ducts and the electricity supply rigged up to his own home supplied light, water and air filtration. Mundy was ordered to pay back £13,480 within six months during a Proceeds of Crime hearing at Manchester Crown Court in February.

Mundy was convicted of producing a Class B drug at an earlier hearing and was given a sentence of 15 weeks' imprisonment suspended for two years, and ordered to carry out 80 hours of unpaid work.

SOURCE: *Mail online*, 5 February 2013

Underground nuclear waste disposal depository rejected by Cumbria

Cumbria County Council, representing the only area to have shown any interest in hosting an underground nuclear waste storage site, has decided to reject the option. The decision is seen as a setback to government proposals for additional nuclear power stations. Copeland District Council, where Sellafield employs nearly 10,000 people in nuclear-related jobs and was favourably disposed, was outvoted by the remainder of the county.

Locations within Cumbria thought to be suitable on geological grounds had been narrowed down to an environmentally sensitive area and Area of Outstanding Natural Beauty comprising the Solway Firth and the National Park 'jewels' Ennerdale and Eskdale. Any depository of high-level waste would have to be excavated in unfractured impervious rock and leak-proof and earthquake-proof for a million years.

SOURCE: WAINWRIGHT, Martin, and Terry MacALISTER, 2013, Cumbria rejects nuclear waste storage proposals. *The Guardian*, 31 January 2013, page 5.

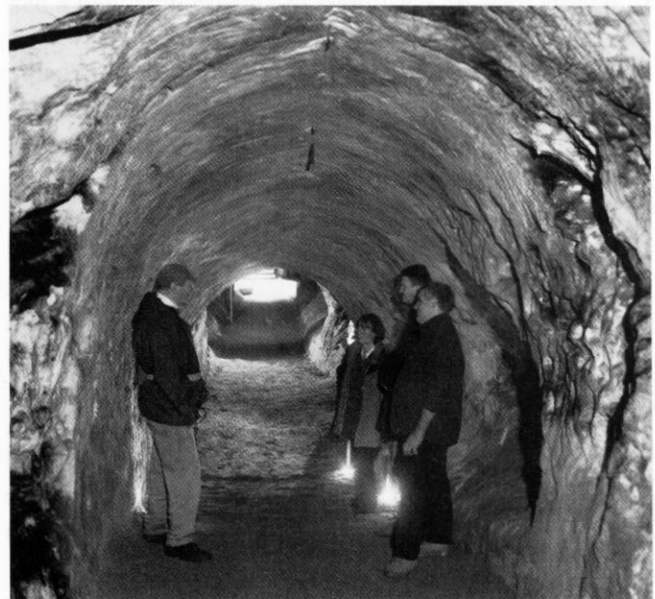
Reigate cave open days in 2013

The Wealden Cave & Mine Society offers guided tours of three 'caves' in central Reigate (east Surrey) on the following five Saturdays in 2013 (between 10.00 and 16.00hrs). Paul Sowan is a member of the team of cave guides. (see page 37)

11 May 8 June 13 July 10 August and 14 September, 2013

The three rock-cut excavations in the Folkestone Sand below the surviving earthworks and site of Reigate Castle (in the park to the north of the High Street) which may be visited are:

The **Barons' Cave**, an enigmatic excavation, possibly a wine cellar-cum-sally-port, first mentioned in print in Camden's *Britannia* in 1586, but possibly an original feature of the 11th-century castle of which otherwise only the earthworks survive. This has been a tourist attraction since at least as far back as the 17th century. The entrance is in the Castle Grounds park. Lights are provided by the guides. There are numerous steps to negotiate.



Former Sub Brit secretary Malcolm Tadd guides a party through Barons' Cave. Photo Nick Catford

The **Tunnel Road East 'caves'**, probably former glass-sand mines which have subsequently been used as wine and beer stores, World War I military stores, World War II shelters and an emergency control centre, etc.

Historical displays feature east Surrey geology and industries, a reconstruction of Surrey's pioneering horse-drawn railway, World War II shelter life, and the Cold War.

The **Tunnel Road West 'caves'**, another glass-sand mine including spectacularly proportioned mine galleries up to four metres wide and five metres high, also once used as a wine and beer cellar and a World War II shelter.

Tunnel Road (pedestrianised), opposite Bell Street in the town centre, is England's oldest surviving road tunnel, made through the castle hill in the early 1820s. The East and West 'caves' tours depart from within the south end of the tunnel. The 'caves' are lit, and floors are fairly level, with a few steps in places.

Entry charges are made, except that there is no charge for the Barons' Cave on Heritage Open Day, Saturday 14 September. For details see www.wcms.org.uk.

Death of Francis Walley [1918–2012]

Francis Walley was an engineer who designed, amongst many other structures, air-raided shelters and other bomb-proof works, command posts, and Cold War bunkers. His public service career included a post at the former Ministry of Home Security Research Section at Princes Risborough in 1941, and work for the Atomic Weapons Research Establishment at Foulness (Essex). He was responsible for designing blast-proof buildings on the one hand, and researching their destruction on the other. He was born on 30 December 1918, and died on 18 October 2012.

SOURCE: ANON, 2012, Francis Walley: structural engineer whose pioneering use of pre-stressed concrete helped shape the townscapes of Britain. *Daily Telegraph*, 3 December 2012.

NEWS – PUBLICATIONS and BOOKS

Dorset stone

DETAILS: THOMAS, Jo, 2008, *Dorset Stone*. Wimborne Minster: Dovecote Press Ltd: 128pp [ISBN 978-1-904-34963-1] £17.95.

Although building-stone has been quarried underground in Dorset, in the Isle of Purbeck west of Swanage, and at Green Hill near Chalbury, northeast of Weymouth, this excellent book has very little to say about the underground workings. But it is an invaluable guide to the geology of the multitude of natural mineral building materials of the county, even including a section on the brick-clays, and to the buildings in which they have been used, and the landscape in which they were quarried and across which they were transported.

Skinningrove iron and steel works, Yorkshire coast

DETAILS: SHEPHERD, Cliff, 2012, *Skinningrove iron and steel works: its history, railways and locomotives*. Industrial Railway Society: 200pp [ISBN 978-1-901556-80-3]

What was to become a massive industrial complex on the cliffs of the Yorkshire coast to the south of Saltburn developed from a small trade in the collection of ironstone picked or dug from the beach for removal by coastal shipping. The move towards opencast and subsequently underground inland extraction commenced in 1847. By 1856 mines were in operation, linked by a tramway to a newly built jetty to facilitate onward transport by ship. Extensions from the Stockton & Darlington Railway were built to serve a number of other ironstone mines, further inland than Skinningrove. Rails were laid in the 1860s and 1870s so that in due course Skinningrove was linked to the national rail network, providing a more satisfactory means of transporting ore to ironworks than coastal shipping.

Numerous new drift mines were opened, including those at Loftus, Whitecliffe, Liverton, Craggs Hall, Carlin How and North Loftus. In the 1870s smelting furnaces were established in the Skinningrove area, as a result of which the rail lines were used to bring fuel and limestone into the district and to send away iron made locally rather than ore. By 1970 the Skinningrove works was a massive complex of furnaces, mills, and rail infrastructure.

Although this handsomely produced and profusely illustrated book is concerned primarily with railway infrastructure and rolling-stock, it is essential reading for anybody interested in the development of the numerous ironstone mines in this district.

The work of cave rescue teams

DETAILS: SMALLSHIRE, Vic, 2012, *The Black Panther*. Dudley Canal Trust: *The Legger* 224, 21–30.

Cave rescue reports often relate to incidents which have nothing to do with cavers in difficulties underground. Members of cave rescue teams are called out to retrieve dogs from mine shafts or wells, for example, or to assist police in the search for missing persons or property.

Vic Smallshire, chairman of the Dudley Canal Trust, has recently published an account of how members of that organisation took part in the search for 17-year-old heiress Lesley Whittle who went missing in 1975. Her body was found on 7 March that year, on the end of a steel wire tether, in a drain shaft connected with the disused Brindley canal tunnel at Kidsgrove, north Staffordshire. In 1976 Donald Neilson (called the Black Panther in newspaper reports) was tried at Oxford for her murder (and others) and sentenced to five terms of life imprisonment. He died in prison at Norwich in December 2011, aged 75.

NEWS – TUNNELS and TUNNELLING

Proposal for public railway rides on the former Post Office Railway, London

The Post Office Railway (more recently called Mail Rail) commenced carrying mail under the streets of London in

1927, was closed in 2003, and has since been mothballed. It ran from Paddington to Whitechapel, and had intermediate stations below central London mail-sorting offices. A small section of the two-foot-gauge line and tunnels could become a visitor attraction, if sufficient HLF funding is forthcoming.

Plans for a new Postal Museum in Royal Mail's surface building at Mount Pleasant include a sub-surface exhibition hall in the former POR rolling-stock depot and workshops. The public visit could include a 15-minute ride in a purpose-built passenger carriage with seats for 30. The one-kilometre ride would descend 70 feet to the Mount Pleasant Station, traverse one of the reversing loops, and then return via the station to the display hall. When operating, the POR / Mail Rail trains were automatically controlled electrically-powered mail bag containers, with no provision for passengers, or even a driver. A small passenger carriage was available for occasional visits by dignitaries. Possibly this was also used by engineers responsible for the track and tunnels.



Mount Pleasant station shortly before closure in 2003.

Photo Nick Catford

When the Post Office Railway was still running, it was quite easy to book visits for interested groups to the subsurface platforms at Mount Pleasant, and indeed Subterranea Britannica members enjoyed such a visit shortly before closure. What has now been proposed, and may or may not happen, is a train ride in the steeply inclined tunnels from the depot to the station, and around one of the tightly curved reversing loops, places hitherto off-limits for public access.

SOURCE: WILLIAMS, Alan, 2013, Mail Rail to be tourist attraction? *Modern Railways* 70(773), page 15.

Closure of Old Vic Tunnels theatre, London

The Old Vic Theatre in Waterloo Road opened a small satellite theatre in tunnels, or built brick archways, under Waterloo Station three years ago, but now proposes to close it as it is 'not making enough money'. Part of the vast complex under the railway tracks was used as an alternative theatre venue and occasional nightclub.

SOURCE: BRYANT, Miranda, 2013, Staff devastated as Old Vic closes its Tunnels theatre. *Evening Standard*, 22 February 2013, page 27.

200th anniversary of the Regent's Canal (and its tunnels), London

Construction of the Regent's Canal, in north London, commenced in October 1812. Two tunnels remain as operational parts of the waterway: the Islington tunnel at 960 yards long, followed by the Maida Hill tunnel (under the Edgware Road), a humbler 272 yards.

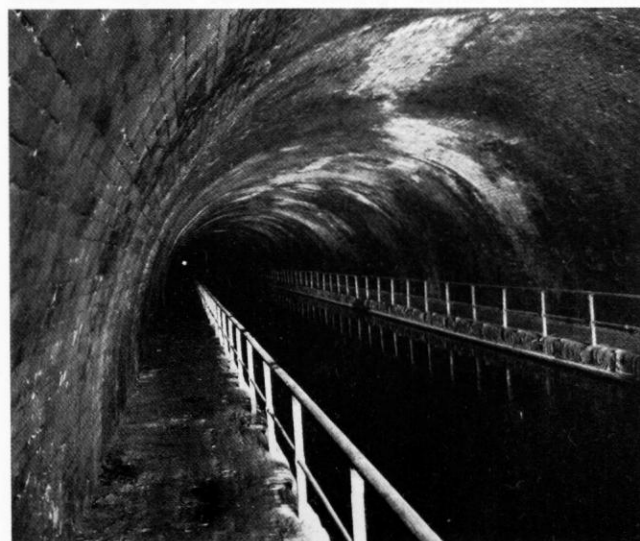
There was considerable apprehension concerning the boring of the two tunnels, as the road tunnel at Highgate had collapsed during construction on 13 April 1812. Nearly nine miles long, and wide enough to take boats 14 feet wide, the canal was opened throughout in 1820, linking a basin at the London end of the Grand Junction Canal to the Thames at Limehouse. The waterway as far east as Camden Town had already been opened in 1816, and extended through the Islington tunnel in 1818. As the architect John Nash [1752–1835], a director of the canal company, solicited and was accorded support for the enterprise from the Prince Regent (later George IV), the waterway came to have its present name, eventually preferred over the alternative North Metropolitan Canal.

SOURCES: CARR, Robert, 2013, *Regent's Canal 200. Industrial Archaeology News*, 164, page 10; and Michael ESSEX-LOPRESTI, 1987, *Exploring the Regent's Canal*. KAF Brewin Books: viii + 80pp [ISBN 0-947732-24-5]

Canal charity begins repairs to Netherton Canal tunnel

The charity which maintains England's canal network has begun a four-month project to ensure the future of a 1.7-mile Netherton tunnel in the West Midlands dating back to 1858.

Costing around £1.5 million, the work on the tunnel will see a new arch created to stabilise a 50-yard stretch of Victorian brickwork. Engineers are also using concrete-filled steel tubes to reinforce a central stretch of the tunnel, which links Netherton, near Dudley, with the Dudley Port area of the West Midlands.



Netherton Tunnel was the last canal tunnel to be built in Britain during the Canal Age and unusually had a towpath on both sides

George Ballinger, head of engineering at the Canal and River Trust, said: “We have been keeping a close eye on Netherton Tunnel for some time and have carried out various repairs over the years, the last being in the early 1980s.

“The centre section of tunnel that will be repaired first as it has really got us concerned and ultimately, if we did nothing, the tunnel could collapse. The works being carried out will help prevent any further movement of the centre section, giving it strength and support for generations to come.”

SOURCE: *Daventry Express*, 8 February 2013

Bigger boys have bigger (and more dangerous) toys in east London

Motor cars, looked at dispassionately, have much in common with ‘unfenced moving machinery’ as noticed in the several Factories Acts: potentially, and actually, lethally dangerous. Used for their primary purpose, getting from A to B, they might be considered a necessary evil. Used as status symbols they could be tolerated as harmless nonsense. But used as playthings is another matter.

According to the MP for Poplar (London), people’s lives are being put at risk by organised late night car races which have since 2004 become a feature of the Blackwall, Dartford, Limehouse Link and Westferry Circus road tunnels in east London. Apart from the racing element, there is also ‘kudos’ to be gained by making as much noise as possible. Not surprisingly, most of the organisers of this tomfoolery prefer to remain anonymous.

SOURCE: FRITH, Maxine, 2012, ‘Fast and furious’ tunnel races are putting lives at risk, says MP. *Evening Standard*, 5 November 2012, page 28.

Italy’s 10-metre Alpine mega-tunnel

After twenty years’ delay because of opposition from locals and environmental campaigners, work on the Italian side of a high-speed rail tunnel designed to link Turin with Lyon in France has finally begun. But with protesters in the woods and hills around the site, the Italian army has been brought in to provide security.



The French side of the Alpine tunnel

For twenty years, a well-marshalled army of local protesters has successfully resisted grandiose Franco-

Italian plans to drill a 57km tunnel through the Alps. They have lobbied tenaciously – and at times violently – in their fight against the rail link between Lyon and Turin. Some 400 people were injured in clashes with the police last year when the tunnel site was first fenced off.

Since then the Italian army has been deployed to keep the site secure. There is clearly embarrassment that – while the French have already drilled and completed 10km of exploratory tunnels – Italian progress on a five-mile tunnel on the other side of the border amounts to a scrape in the mountainside approximately 10m deep.

The EU has backed the tunnel ever since its inception in the early 1990s, but its leaders agreed last week to cut the overall budget for the union for the next six years – and grand infrastructure projects could be vulnerable.

Last year, the French Court of Auditors projected that the final bill for the tunnel would be double the 13bn euros envisaged in the 1990s. It would end up costing more than the Channel Tunnel. Nor, concluded the court, was there any certainty that it would ever return a profit.

SOURCE: *BBC News Magazine*, 15 February 2013

London Underground Northern Line extension proposed in south London

For a number of reasons, including geology and nineteenth-century railway company economics, south London has a much sparser network of underground railways and stations (but a denser surface lines and stations system) than north of the Thames.

Apart from their locations at or below the surface, the rail networks differ in that London Underground generally provides more frequent train services than the South West Trains, Southern, and South Eastern companies. The development of London Overground to some extent bridges the gap. Former East London Line services have been extended to Croydon and Crystal Palace with LU frequency but almost entirely on already existing track. And a link which has displaced the former London Bridge to Victoria services on the South London Line is a further step towards the completion of an orbital railway for the capital.

But now new tunnelling is proposed, extending the Northern Line from its present Kennington terminus to Nine Elms at Battersea. The twentieth-century Jubilee Line extension and before that the Victoria Line to Brixton may now be joined by a new set of south London sub-surface stations.

SOURCE: Battersea Northern Line extension heralds London expansion. *Modern Railways* 70(772), 12–13.

Egypt floods smuggling tunnels connecting Sinai and Gaza with sewage

The Egyptian military is resorting to a pungent new tactic to shut down the smuggling tunnels connecting Sinai and Gaza – flooding them with sewage. Along with the stink, the approach is raising new questions about relations between Egypt’s new Islamist leaders and their ideological allies in Hamas who control the Gaza Strip.

“Awful”, said Abu Mutair Shalouf, a Palestinian smuggler on the Gaza side, watching workers haul buckets of sewage-soaked soil from the shaft of a tunnel flooded by the Egyptian military 15 days earlier.

Advisers to the Egyptian president Mohamed Morsi explained, “We are determined to shut the tunnels to block the destabilizing flow of weapons and militants into Sinai from Gaza. After the sewage flooding, several Hamas officials instead emphasized Egypt’s right to protect its borders as it chose.”

SOURCE: *New York Times*, 20 February 2013

Geological complexity at new Crossrail tunnels at Farringdon, central London

One factor which made London such a favourable location for the world’s first underground railways, and especially the deep tube railways, was the happy circumstance that much of the city lies on a thick bed of London Clay at or just below ground level. The answer (one of several) to the often-asked question why the London Underground system is so much better developed north of the Thames than it is to the south is that in the latter district considerable areas are underlain by rocks less ideally suited to tunnelling, such as waterlogged quicksands, pebble-beds, and flinty chalk.

Unfavourable ground underlies Farringdon, where the thickness of London Clay is insufficient, and its depth too shallow, to host the intended Crossrail running tunnels and sub-surface station works.

Data from numerous bore-holes entered into 3D modelling software has allowed engineering geologists to see in advance exactly what sort of ground will have to be tunnelled through. The tunnel-planners, followed by the tunnellers themselves, will have to penetrate a thickness of 15 to 20 metres of Lambeth Group beds (clays and sands) in which the several beds vary considerably in nature and thickness over quite short distances. The scenario is additionally complicated by this block of strata containing dislocations of rock units, vertically if not laterally, by at least seven geological faults. SOURCE: ALDISS, D.T., M.G. BLACK, D.C. ENTWISLE, D.P. PAGE, and R.L. TERRINGTON, 2012, Benefits of a 3D geological model for major tunnelling works: an example from Farringdon, east-central London. *Quarterly Jl. Engineering Geology and Hydrogeology* 45(4), 405–414.

Crossrail 2 proposals for London

With what seems likely to be called, eventually, Crossrail 1 under construction east–west below London (eastbound tunnel boring machine 1, named Phyllis, is currently somewhere below Hyde Park, heading for Bond Street), planning has commenced for a similar line to pass north–south below the centre of London.

As with so many major cities, when first served by intercity rail lines there were termini around the edge of the central area: travellers travelling to and then beyond the city had to walk across the centre, or take a cab, or take a bus or an urban metro train. London is late on the

scene in so far as joining termini with subsurface rail extensions is concerned. Berlin, Brussels and Paris, for example, have provision for fast trains (as well as Metro) below their centres.

Like Crossrail 1, Crossrail 2 is not envisaged to take long-distance main-line trains, such as Manchester to Brighton, but will provide through services (as does Thameslink already) for regional trains and outer suburban lines. Crossrail 2 services, it is proposed, will run from Chessington, Epsom, Hampton Court, Shepperton and Twickenham northwards through a new tunnel commencing at Wimbledon and a sub-surface station at Clapham Junction to further new stations below ground level at Victoria, Tottenham Court Road and King’s Cross St Pancras to two tunnelled routes beyond Angel Islington. One northern branch, entirely in tunnel, would terminate at Alexandra Palace. The other branch would emerge to ground level beyond Hackney and terminate at Cheshunt.

Peak-time passenger congestion at Victoria and King’s Cross St Pancras would be greatly alleviated, as would overcrowding on the Victoria Line. And Clapham Junction, notoriously a major station with no associated tube line station, would have a direct connection into the West End.

This scheme is estimated at present to cost £12bn, and would provide for an additional 100,000 morning peak-hour journeys. Passengers could cross right into central London, from Kingston to Tottenham Court Road, in 22 minutes. Construction could be started in the early 2020s, with completion in the mid 2030s.

To rely entirely on new road construction to cope with the estimated future demand would be immensely more expensive, and achievable only by wholesale demolition of large parts of the centre of London, the very places people will want to visit. The urban motorway cutting a swathe through central Glasgow stands as a dreadful warning!

SOURCE: BEARD, Matthew, 2013, Mayor backs Crossrail 2 to slash north–south journey times in capital. *Evening Standard*, 5 February 2013, page 4.

Proposed new deep-level sewer, London

Following the Brunels’ first ‘Thames tunnel’ there have been many others, some identically named, under the capital’s river. Most of them convey railways, roads, cables, pipes or pedestrians from one bank to the other. However, Thames Water’s proposed new ‘Thames Tunnel’ will, if or when made, do no such thing.

Rather, it will be routed more or less below the bed of the Thames, cutting a few corners here and there. Its purpose would be to supplement London’s main drainage system as installed in the nineteenth century by Joseph William Bazalgette [1819–1890]. Bazalgette’s sewers have, remarkably, served the growing city very well indeed for well over a century. But now the peak flow (after heavy rainfall) is too much for the system to cope

with as it stands. Raw, if diluted, sewage has to be discharged into the Thames via overflow sewers from time to time.

There is general agreement that something has to be done about this. But there is also considerable concern that digging a huge tunnel from one side of the capital to the other would be very disruptive. Enormous volumes of London Clay and other materials will have to be excavated and transported to wherever it is to be dumped. It could be countered that Thames Water's last big tunnelling project, the London Ring Main for water supply, was completed without much fuss!

Tunnelling under city streets has a long history. The Romans had a sewer system under York in the first century or so after they arrived in AD 43. Exeter has an extensive cut-and-cover system of water supply tunnels (part of it open to tourists) developed in the Middle Ages. SOURCE: BAGGS, Martin, 2010, Thames tunnel major project report. *New Civil Engineer Supplement*, October 2010: 44pp.

East Croydon Station subway closed

On and from Monday 7 January 2013 the subway and its three approach ramps linking all six platforms at East Croydon Station was closed. A sub-surface extension below platform six to railway premises on the east side of the station had already been closed for some decades. On the same day a new footbridge at the London end of the station, with flights of steps to the three pairs of platforms, was opened.

Planned additional station entrances for passengers on the east and west sides are not yet opened. Step-free access between the platforms and to and from the booking hall at the George Street end of the station is via ramps. There are no lifts at the station, although these are promised serving the new footbridge later in the year.

Subterranean matters at Woldingham, Surrey

Former SB Chairman Paul Sowan is the author of three of the chapters in a newly published book about the history of Woldingham, a rather isolated hilltop village reputedly harbouring one of the UK's densest clusters of millionaires. All three chapters (on the geology of the parish, the ground-water and mineral resources underneath it, and a long and relentlessly curved railway tunnel below it) make reference to proposed and in some cases realised underground developments.

The property speculator William Gilford [1827–1902] bought virtually the whole (admittedly quite small) parish in 1880, with a view to its profitable development when the Croydon to Oxted railway (then in course of construction) was completed, improving accessibility. What he did was to sell off large building-plots with the stipulation that they were not to be sub-divided, and that only large and expensive houses were to be built, each in its own grounds. That may have been his 'Plan B' for making money from his investment.

Gilford, an amateur geologist, took an interest in things subterranean, leading an underground visit in the sand

mines and underground quarries at nearby Godstone on 12 August 1882 for example. He took a strong interest in the question of the possible existence of coal deep below the North Downs, extending the reasoning of Robert Alfred Godwin-Austen [1808–1884] who had published in 1856 a suggestion that the coal seams in Somerset and northern France might run continuously from the one district to the other (in fact, they don't). Had coal existed and been workable under Woldingham, the village might have been dominated by 'Plan A' shale tips and winding headframes, rather than mansions! In fact Gilford's only excursion into applied geology was the sinking of a deep well and establishment of a small local water company to supply Woldingham and Chelsham parishes. The closest the village ever got to the coal-mining industry was to provide a home for the late Lord Robens, head of the National Coal Board.

For reasons which have hitherto not been clear, the engineer and surveyors for what was at first to have been the Surrey & Sussex Junction Railway opted for a long (2266 yards) relentlessly curved tunnel under Woldingham. This tunnel appears to be quite if not almost unique amongst England's mile-plus Victorian era tunnels, almost all of which are dead straight from portal to portal. Paul Sowan suggests that the reasons for this anomalous design are partly a question of the landowner's vested interests in the enjoyment of his estate, and partly a question of tunnelling economics. The compromise curved alignment had the railway out of sight from the Marden Park mansion, avoided the destruction of a part of Great Church Wood by shaft-sinking, and although the curved tunnel is obviously longer than a straight one, brought about a considerable saving in shaft-sinking and water-raising by passing under lower parts of the hill.

SOURCES: SOWAN, Paul W., 2012, Woldingham geology; The water under Woldingham; and Practical geology: the hoped-for but non-existent coal and the enigmatic railway tunnel. [Chapters 2, 3 and 6 in: Gwyneth Fookes and Roger Packham (eds), 2012, *Village histories. 10. Woldingham*, pages 11–18, 19–21 and 41–50]

Driving the new Hindhead (A3) road tunnel, Surrey

On the completion of major civil engineering projects there is usually a published overview of what was done, why it was done, how it was done, and when it was done. Such reports are a regular feature of the Institution of Civil Engineers' journal *Civil Engineering* and of supplements to its magazine *New Civil Engineer*. For the largest projects, such as the London Crossrail, periodic reports on progress are also similarly published from time to time.

In the November 2012 issue of *Civil Engineering* there is such an overview of the driving of the Hindhead road tunnel in southwest Surrey (visited by Subterranea Britannica towards the end of its construction). This twin-bore 1.8 km road tunnel lies within a 6.4 km new road on the A3 route and was driven to by-pass traffic congestion in Hindhead and the Devil's Punch Bowl Area of



Outstanding Natural Beauty in southwest Surrey. Planning for this solution to congestion at the traffic lights at the junction of the A3 and A287 roads in Hindhead could be said to have started in the 1950s, but no viable surface-level bypass was found to be feasible on account of the deeply incised valleys around Hindhead, and the National Trust and Site of Special Scientific Interest status of much of the open land.



Tunnelling commenced in February 2008, with all tunnel spoil used within the overall contract site. Much went into bunds to act as sound barriers to protection nearby properties and public open space from traffic noise. Some was also used to restore ground levels to their original profiles when the by-passed part of the A3 was removed through the AONB. The new route was opened to traffic (currently of the order of 38,000 vehicles per day) on 27 July 2011, on time and within budget (the cost was £ 371m).

In line with current road tunnel safety requirements, there are 16 cross-passages linking the two tunnel bores, allowing for escape routes in the event of a fire. Quite apart from the tunnelling itself, this is heavily engineered infrastructure, with staffed control rooms at either end and provision for lighting, ventilation, CCTV surveillance (102 cameras), fire detection and so forth.

Peace and quiet has returned to the open land above, and to Hindhead.

SOURCE: ARNOLD, Paul, 2013, Going under the Devil's Punch Bowl: the story of the A3 Hindhead tunnel, UK. *Civil Engineering [Proc. Institution of Civil Engineers]*, 165 (CE4), 162–170.

New light on (if not in) the Dudley Canal tunnel

The Dudley Canal tunnel, driven in the late eighteenth century, communicates with an intricate complex of fluxing limestone mines in the Black Country town. An article on 'Lord Ward's canal' (from Dudley Junction, Tipton Green, to Castle Mill Basin) was published in 1976 in *Contact*, the journal of the Friends of the Black Country Museum. The author of that account has now published additional historical details based on further research.

SOURCES: LANGFORD, J. Ian, 1976, The canals of Castle Hill. 1. Lord Dudley's Canal. *Contact* 5*(4); and J. Ian LANGFORD, 2012, Lord Ward's Canal. *Dudley Canal Trust: The Legger* 224, 16–20,

Channel Tunnel fire

A fire occurred on one or more vehicles on an eastbound HGV shuttle train on 29 November 2012, although very little damage was done apart from a burnt-out lorry. The fire was detected by heat sensors, and the train was driven out to sidings at the French end of the tunnel where fire engines attended. Tunnel traffic was halted for about two hours while checks were made.

SOURCE: ANON, 2012, Fire in tunnel averted. *Today's Railways Europe* 205 (for January 2013 / published December 2012), page 6.

Another bank robbers' tunnel, Berlin

On 14 January 2013 a bank robbery was detected when staff detected smoke coming from the safe deposit vault. Investigation revealed that robbers had tunnelled into the space from an adjoining sub-surface some 30 metres away, stolen the contents of the boxes, and started a fire to destroy evidence.

A previous Berlin bank robbery involving criminal tunnelling took place in 1995. On that occasion the thieves entered through the front door, took a hostage, and demanded a ransom. Police stormed the safe vault to which the gang had retreated, only to find they had escaped via a getaway tunnel dug by accomplices.

SOURCE: ANON, 2013, Berlin police hunt bank tunnel getaway gang. *The Guardian*, 15 January 2013, page 22.

Proposed new cross-city rail tunnel for Gothenburg, Sweden

In the early days of railways, built by separate private companies, termini were often built around the then perimeters of major cities. Anybody wishing to continue their journey beyond the city had to walk or hire a cab (or, more recently, take a bus or tube train) across the city centre. In London this problem has been addressed for London Bridge to Kings Cross St. Pancras journeys by reopening the freight line via Farringdon to passenger trains; and will shortly be avoided for Paddington – Liverpool Street passengers by the completion of Crossrail.

In Brussels the North and South termini were joined by an under-city tunnel (and a subsurface Central Station) in the 1950s, so since then it has not been a problem for through trains from Paris via Brussels to stations in Germany and the Netherlands, and even sleepers to Berlin, Warsaw and Moscow. In Manchester you still have to take a tram from Manchester Piccadilly to Manchester Victoria; and Glasgow is in a similar position. Stockholm, sensibly, has a through station although, as a result of suburban traffic congestion, a tunnel is currently under construction to take new lines under the existing tracks to increase capacity; Sub Brit members visited this site during the recent Study Weekend in Sweden.

Sweden's second city, Gothenburg, is now about to have a 9.7 km cross-city double-track rail tunnel which will benefit passengers on the Copenhagen – Gothenburg –

Oslo route, on which through trains currently have to enter into the city terminus and then reverse out again to continue northwards. Antwerp and Leipzig have recently done the same with their city-centre termini.

ANON, 2013, Sweden: EU funds for Gothenburg cross-city tunnel. *Modern Railways* 70 (774), page 85 [Proposed 9.7 km double-track tunnel for through trains]

Cheese lorry fire in the Brattli road tunnel near Tysfjord and Narvik, northern Norway

That road tunnels are inherently dangerous places, especially if used by lorries carrying flammable materials, was brought home to the world at large by the disastrous fire in the Mont Blanc tunnel near Chamonix in April 1999, when 41 people died.

On 17 January 2013 the 1.9 mile (3.04 km) Brattli road tunnel at Tysfjord near Narvik in arctic Norway was closed as a result of a lorry-load of 27 tonnes of brown cheese catching fire. The Narvik tunnel fire raged from 17 to 21 January, resulting in closure for at least the best part of a week. Fortunately there was only one other vehicle in the tunnel at the time, and nobody was hurt. Narvik in the winter is a somewhat remote place, with

(unlike Chamonix) little tourist or even local traffic. Much of the freight traffic comes by rail from Sweden via Kiruna.

When sufficiently hot, the fat content of cheese is as disastrously flammable as petrol. From memory, one of the flammable materials responsible for the Mont Blanc tragedy was margarine. And of course the very geometry of a tunnel results in a (horizontal) chimney effect, hot gases from the fire creating a convection current which fans the flames.

The Mont Blanc fire resulted in a re-examination of road tunnels throughout Europe, and probably world-wide, and the commissioning of expensive safety works at a great many of them, not least in the UK. Tellingly, Beard and Carvel's *Handbook of tunnel fire safety*, published as recently as 2005, has already come out in a new edition. SOURCES: ANON, 2013, Cheese on toast has tunnel in meltdown. *Metro*, 24 January 2013, page 20; ANON, 2013, Whey too hot! Cheese fire closes road tunnel. *The Guardian*, 23 January 2013, page 18; BEARD, Alan, and Richard CARVEL (eds), 2005, *The handbook of tunnel fire safety*. London: Thomas Telford Ltd: xxii + 514pp [ISBN 0-7277-3168-8]

Water Supply Aqueducts, Tunnel and Cisterns of Byzantine Constantinople, Turkey

Paul W Sowan

Thrace, the small European part of modern Turkey, which shares frontiers with Greece and Bulgaria, lies on the west side of the Bosphorus. It included the ancient Greek city of Byzantium, established on the most easterly of the seven hills of modern Istanbul, about 657 BC, but subsequently destroyed. A new city was built on the site by the Roman emperor Constantine I [c. 288 – 337] in AD 330, and was for a time the capital of the Roman Empire in the east, and later the capital of Turkey although it lost this status to Ankara in 1923.

Some of the relatively well-known Roman covered water cisterns in the city are established tourist attractions. Very much less well-known is the very extensive system of aqueducts built to conduct water from the hills of Thrace into the city.

James Crow and others have now reported on a ten-year archaeological investigation of this water supply system in Turkey-in-Europe, and in European Istanbul, in its entirety. This is published as a substantial monograph of the Society for the Promotion of Roman Studies.

Constantinople's three engineered water-supply channels have a total length of at least 592 kilometres, somewhat longer than the total length (520 kilometres) of Rome's 11 aqueducts. The aqueducts in Thrace were maintained and remained in use up to the late 11th century. They were built to allow a continuous and steady flow of water from as far distant as the Stranja Hills (up to 1000 metres) and took very sinuous paths, generally following the contours of the forested hilly country. At times ravines or valleys were bridged (the Aqueduct of Valens, in the

city, has a length of 971 metres); and short stretches of higher ground were passed via tunnels. A number of tunnels have been examined internally, and the locations of several tunnel shafts (presumably for spoil extraction) have been identified. The water channels were almost exclusively constructed by the cut-and-cover method, and those on the surface were covered, presumably to reduce water loss by evaporation.

Whereas chapters 3 – 4 deal with the water channels outside the city, the following two deal with water distribution and storage within Constantinople, where there are or were an estimated 150 covered cisterns and open reservoirs. Chapter 7 deals with Christian and other symbols inscribed on the masonry, and Chapter 8 with masons' marks, followed by a general discussion in Chapter 9.

The volume includes numerous maps, site plans, measured drawings of built structures, and measured ground plans of cisterns and reservoirs. An appendix contains English translations (from, *inter alia*, Bulgarian, French, Greek, Latin, and Turkish sources) of major texts and inscriptions. There is a 13-page bibliography and an 8-page index.

DETAILS: James CROW, Jonathan BARDILL, and Richard BAYLISS, 2008, The water supply of Byzantine Constantinople. *Journal of Roman Studies Monograph* 11: xiv + 272pp [ISBN 978-0-907764-36-6] [Details of availability from The Roman Society, c/o University of London, Senate House, Malet Street, LONDON WC1E 7HU]

Peenemünde and the Vengeance weapons

A historical perspective

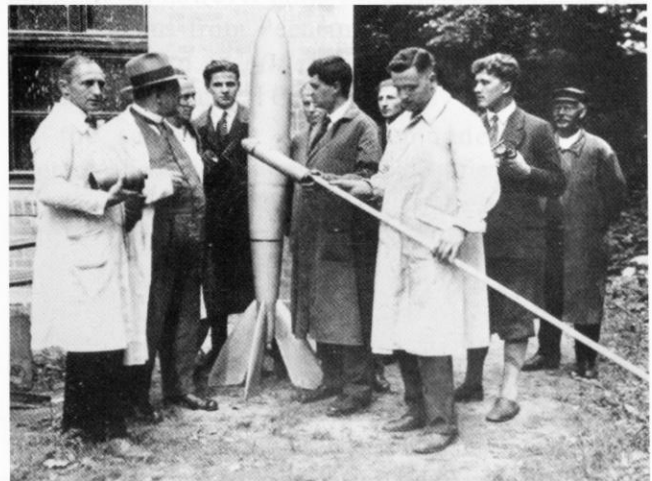
Martin Dixon

The Beginnings

Many people know of the so-called 'Vengeance' (German *Vergeltungswaffen*) weapons and the terror they caused in the latter months of World War II. It is easy to assume that they were developed in a final desperate measure to turn the tide against the relentless advance of the Allies in continental Europe. But, in fact, the weapons have their roots as early as 1919 and the Treaty of Versailles. This treaty, which formalised the end of World War I, forbade Germany to develop long-range artillery.

Self-propelled rockets fell outside this treaty and so Germany invested significant energy into rocket research. The later-developed V-1, predecessor of the contemporary cruise missile, was also not directly covered by the ban but arguably contravened the by-then notional prohibition on Germany's possessing an air force.

The German Army started research into rockets in 1929 at Kummersdorf, about 30 km southeast of Berlin, under the command of Captain Dornberger. In 1932 it was Dornberger who recruited the young Wernher von Braun, who later became synonymous with the German rocket programme.



By 1932 Wernher Von Braun, was already constructing and experimenting with small rockets. Wernher Von Braun undertook several experiments on rocket engines for the German army beginning in 1932, and in 1934 he presented his doctoral thesis on rocket propulsion.

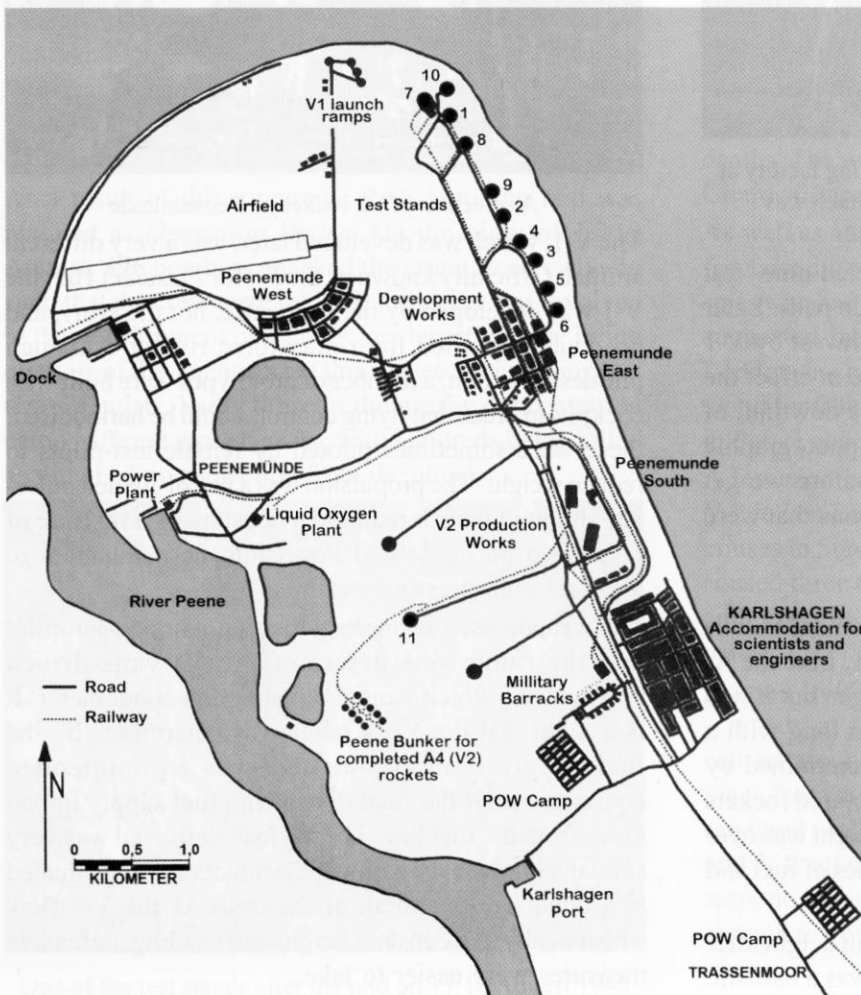
The first operational rocket developed under these two scientists was the A-1, fuelled by alcohol and liquid oxygen and a modest metre and a half long. Test-firing rockets was clearly going to need a facility away from populated areas and so the search began for a suitable site.

In 1936 the location chosen was Peenemünde, a remote peninsula on the Baltic coast island of Usedom. The site allowed research and development to be undertaken in secrecy and for test launches to take place in relative safety out to sea.

A frenzy of building

Within months, the site was developed from virgin forest. The army, and hence rocket, facilities were known as *Heeresversuchsanstalt* (Army Research Centre) Peenemünde or HVP, and formed the eastern and southern portion of the site. The Luftwaffe occupied a smaller site to the west known as *Erprobungsstelle der Luftwaffe* or Luftwaffe Test Site.

Infrastructure development included a wind tunnel, liquid oxygen factory and a 30-megawatt power station. A complete town called Karlshagen Siedlung (Housing Estate) was built which housed three thousand scientists and engineers. To the south were barracks for the military presence on site; also to the south was a concentration camp known as KZ (Concentration Camp) Karlshagen. In



this camp forced labour in the form of Russian and Polish prisoners were housed in appalling conditions and provided the bulk of the construction team.



This is test stand number 1, one of several test stands built at Peenemünde. Rockets underwent static tests, and were then launched over the Baltic Sea seen in background



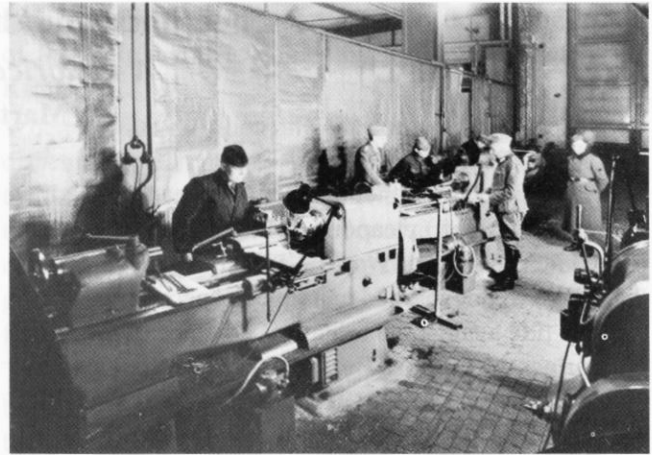
Test Stand 7 was the principal V2 rocket testing facility at Peenemünde. The first successful V2 launch was made from here on 3 October 1942

To the northeast of the site were constructed nine 'test stands', or what we would today call launch pads. Later these would be complemented in the northwest by V-1 launch ramps. These launch facilities were in effect the business end of the site and were to be the downfall of the site due to the Allies' excellence in photographic reconnaissance and interpretation. But before we get ahead of ourselves, a little about the weapons that were developed at Peenemünde.

The V-weapons

The V-2 was a long-range rocket known by the Germans as the A-4 – a direct descendant of the A-1. Like the A-1 it was fuelled by alcohol and liquid oxygen but it was very much larger, being around 14 metres long with a diameter of 1.65 metres. This size was determined by the need to be able to transport the manufactured rockets on the German rail network. The launch weight was over thirteen tonnes, including around nine tonnes of fuel and a payload of a mere one tonne.

The rocket reached around 100 kilometres in height after which it effectively fell to earth (hence it was a ballistic



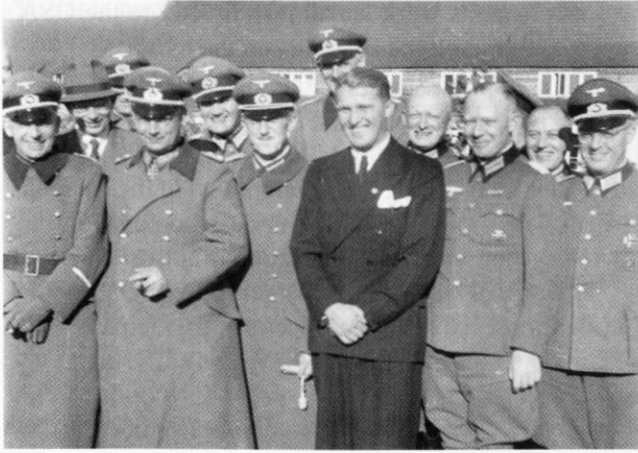
Soviet prisoners under supervision at lathes in a workshop (missile), reaching around three times the speed of sound at impact. It was impossible to defend against attacks at this speed so destruction of the manufacturing and launch facilities was the only real defence. It was however an expensive way to deliver a warhead as each rocket took around 13,000 man hours to build.



A selection of V2 rockets at Peenemünde

The V-1, which was developed later, was a very different animal. Officially known as the Fi (for *Fieseler*) 103, the V-1 was developed by the Luftwaffe, not the army, and no doubt benefited from inter-force rivalry. Although pilotless in action, a number of prototypes were built with cockpits in order that flying controls could be harmonised; these were sometimes piloted by female test-pilots to reduce weight. The propulsion was a petrol-fuelled pulse-jet, although launch required a boost using a mixture of Hydrogen peroxide and Potassium permanganate to generate high-pressure steam.

The weapon used a simple gyroscope-damped autopilot and the range was determined by a vane-driven anemometer which wound down a pre-set odometer. It is a myth that the V-1's range was determined by the fuel supply running out; this was an unintended consequence of the final dive as the fuel supply tipped away from the fuel line. The payload delivered was very similar to the V-2 above, but the production cost estimated at around one twentieth of the cost. As the V-1 flew subsonically at a constant height and heading, defensive measures were easier to take.



Top military personnel visiting Test Stand 1.
 From left to right: Colonel Walter Dornberger,
 General Friedrich Olbricht (with Knight's Cross),
 Wilhelm Ritter von Leeb and Wernher von Braun

Detection and Attack

Although intelligence sources (including the so-called 'Oslo Report' from German scientist Hans Mayer) alerted the Allies to the development of long-range weapons, it was photographic reconnaissance that provided the breakthrough. Duncan Sandys led the investigation under the Bodyline Committee (later to become *Operation Crossbow*).

In June 1943 Peenemünde was photographed several times; crucial photographs were taken by Flight Sergeant Peek in a Mosquito on the 23rd. Back in the UK, two photographic interpreters at RAF Medmenham (Wing Commander Hamshaw Thomas and Flight Lieutenant André Kenny) at last found what they were looking for – two rockets on vehicles adjacent to a test stand.

As a result of this a massive RAF bombing raid was planned as *Operation Hydra*. On the night of 17-18 August, 596 bombers attacked the target, secrecy being such that the crew were told that the target was involved in the development of radar. A key target was the living quarters of the scientists but this succeeded in killing just two scientists. Sadly those in the nearby concentration camp suffered more heavily, with hundreds being killed as they had no protection from the attack.



One of the test stands after the raid on 17/18 August 1943

RAF casualties from this raid alone totalled 40 planes and 215 aircrew. Analysis suggests that the V-2 programme was delayed by around two months by this attack. It did however initiate the move of construction of V-weapons from Peenemünde to an underground facility known as *Mittelwerk* ('Central Works') at Nordhausen in central Germany.

At the same time as Peenemünde was being photographed, the interpreters had identified construction sites in the Pas de Calais with what appeared to be launch ramps and perhaps storage buildings. Immense structures at Watten and Wizernes (now better known as Eperleques and La Coupole, and visited on several Sub Brit trips) were also detected and deemed to be rocket storage and launch sites. This initiated further massive-scale bombing attacks by both the RAF and the USAF. Eventually, in late 1943, a V-1 was detected on its launch ramp in Peenemünde by Flight Officer Constance Babington Smith at RAF Medmenham, and the connection between missile and launch site was made.

Launch in anger

Just a week after D-Day, the first V-1 was launched at London (using a fixed launch ramp, the target was built into the construction). This was the first of around 9,500 doodlebug (as the V-1 became universally known by the British) attacks.

Until the launch sites were liberated in the months following D-Day, a combination of anti-aircraft guns, fighter patrols and barrage balloons formed the UK's defences. Around two and a half thousand V-1s reached London, causing huge damage and around six thousand deaths. The worst incident killed 121 when a V-1 hit the Guards Chapel at Wellington Barracks.

As well as attacking the missiles themselves, the Allies fed false information to the Germans through German spies who had become double agents. This misinformation suggested that many V-1s were overshooting central London, encouraging the Germans to reduce their range. Good for Chelsea residents but less good news for those in Penge and Croydon.

A few months after the V-1 campaign started, the first V-2 fell on London on 8 September 1944. The rocket hit houses in Staveley Road in Chiswick, west London, and caused three fatalities. It was initially described by the authorities as a gas explosion in order to minimise public panic.

Around 1,400 V-2s were eventually launched at the UK – mostly at London – and they are estimated to have caused around 2,500 deaths. All of the launches took place from mobile sites, the protected sites having been rendered useless by Allied bombing. Eventually the V-1 and V-2 attacks both ceased in March 1945 as there were no longer any launch sites in German hands close enough to London.



Not all the V2 launches from Peenemünde were successful. This example fell straight back to earth and landed on the railway sidings

Conclusion

Work at Peenemünde led to the development of the forerunners of today's intercontinental ballistic missile (ICBM) and cruise missile. Although the V-weapons didn't materially impact the end of World War II, their successors are still key components of today's warfare

Peenemünde visit

Adrian Trice describes the private visit by Sub Brit members in September 2011.

Many years ago, as a teenager, I picked up an *After The Battle* magazine dated 1974 entitled "The V-Weapons". I still have the magazine; I was absolutely fascinated by the World War II rocket programme and I remember looking in the family atlas to find out where Peenemünde was – it was apparent that a visit would be near impossible as it lay on the Baltic coast well into East Germany.

Fast forward thirty years or more, and I jumped at the chance to visit Peenemünde. Our party arrived at the meeting point in the car park at the edge of the old East German airfield and met our guide. We then split into two groups and boarded the guide's vehicles.

After a short briefing we drove from the car park to our first stop at the railway platform; our guide pointed out the marking on the long-disused rails GHH 1936. Next we stopped at the site of the Guardhouse for the complex – there was not much left apart from some period pipework and the foundations of the building, which still retained some of the original flooring tiles.

Our guide then drove along to some gates and unlocked them; we were now off the public tour route and into the restricted area. Our first stop was at a former Soviet / NVA vehicle garage; this dated from the Cold War period and was a good example of the area's continued military use since the end of WWII. Nearby was an earlier garage block that had been demolished and a Cold War garage built with steel beams and clad in corrugated asbestos cement panels; this building was in very poor condition.

Our guide pointed out some foundations that lay just inside the woods at the side of the road; this was the site of the supersonic wind tunnel. This had been removed to Russia

and von Braun's work led almost directly to the USA's success in landing the first man on the moon.

As well as approaching ten thousand civilian deaths from the deployment of the weapons, and the injury of countless thousands more, we should also remember those who gave their lives during the development of the weapons. British, Commonwealth and American bomber crew and countless thousands of slave labourers and prisoners-of-war also died during the construction and resulting conflict. Let the immense concrete structures that remain act as a lasting memorial to their bravery and suffering.

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Scarborough House (1991)



Little can be seen at Peenemünde without going in to the restricted area. The long railway loading platform can still be seen alongside the road

just after the war ended – the concrete is now the only remains of this once impressive building. It was becoming very clear that what we were seeing was not only the results of destruction by Allied bombing in 1943 but also of later demolition by the Soviets after the war had ended. Our next stop was the site of the Wasserfall anti-aircraft rocket test stand with stunning views of the Baltic coastline in the background. A concrete pad and a small electrical distribution cabinet still survived. All around us was the evidence of the Allied bombing raids – broken concrete and flooded bomb craters. The latter had become home to the newest residents of the area – mosquitoes; many of our party provided easy pickings for them, especially those of us wearing shorts!

The VII test stand (from where the first A-4 was launched)

We passed part of a military assault course which was being recovered by nature and then onto the highlight of our tour, the site of the largest test stand – number VII.

The area has at first sight been recovered by nature with many mature trees, but our guide pointed out the features that have survived the years with the help of period photos to help orientate us. The rails for the test stand are still in existence as are the control cable and the liquid oxygen ducts.

The actual site of the test stand still has its concrete blast deflection pit; this has now flooded but the sloping sides were very easy to see and helped to give some scale to the whole facility. Once again, rubble and bent reinforcing bar lay all around us in the surrounding wooded area.

After a short walk we stopped by an original fire hydrant still standing in the woods, the casting on the valve showing its place of manufacture as Magdeburg and retaining its ZU and AUF markings. The hydrant was clearly visible in our guide's period photos and was a good waymark to aid the interpretation of the pictures. Nearby there was a small granite monument depicting an A-4 rocket; our guide spent some time explaining the workings of the test stand and surprisingly the early use of CCTV to remotely view the launches.

V-1 launch ramps and the museum

We rejoined our vehicles and drove to the first V-1 launch ramp. This was broken up into concrete sections but still pointed in the direction of the Baltic and it was a good example of the scale of the launch ramp. Across the clearing were another two launch ramps in better condition and also a small observation bunker which was also in good repair. There were parts of rockets and also bomb cases lying around this area and our guide explained that some of these had been caught in local fishermen's nets and returned to the site. Our tour had now come to a close and it was time to stop for a welcome break.



The remains of four experimental V1 launch ramps can still be seen north of the airfield

After lunch we visited the vast power station which now is the home to the Peenemünde Historical and Technical Information Centre. This power station produced electricity from 1942 until its closure in 1990. The reception building and bookshop are housed in the former bunker control room for the plant which is unusually remote from the turbine hall.

The external area has several interesting exhibits – a V-1 flying bomb and Walter split-tube catapult launching ramp; an A-4 rocket and two S-Bahn carriages from the Peenemünde works railway. Standing in the museum entrance lobby are two A-4 nose cones, one intact and one rather crumpled – a gentle reminder of why the museum exists. We made our way upstairs to the vast switch room which may well be the last remaining example of a 1940s control room; its size is rather staggering.



At the Peenemünde museum there is an example of a V1 and a V2. In the background the two S-Bahn carriages from the works railway can be seen.

We passed through the museum which contains a wealth of period exhibits and models of the facility – many of the component parts of the A-4 rockets are cut open to show their inner workings and the quality of engineering involved. After a view of the cathedral-like boiler house we left the museum and walked along the quayside, stopping for a much needed drink.

A submarine and a memorial

Since 1998 the Soviet submarine U461 has been tied up alongside the harbour wall and we decided to pay it a visit. The Juliett-class submarine was built in the early 1960s and served with the Red Flag Baltic Fleet well into the 1980s. It was armed with four Intercontinental Ballistic Missiles which could be fired once the vessel was at sea level. The submarine also carried a variety of torpedoes.

The visit was a fascinating insight into the life of the submariner. It is such a shame that we have a Soviet submarine moored up and slowly rotting away in the UK alongside Rochester Bridge in Kent; with funding, it too could become a great visitor attraction like U461.

Returning to our cars, we drove to the Karlshagen memorial for the slave labourers who died in the Trassenheide camps. It is a fitting reminder of the true cost of war. Alongside the memorial is a large German cemetery which houses the graves of many people killed in the air raids; one grave marked a family who lost six people on the same date – 18 August 1943.

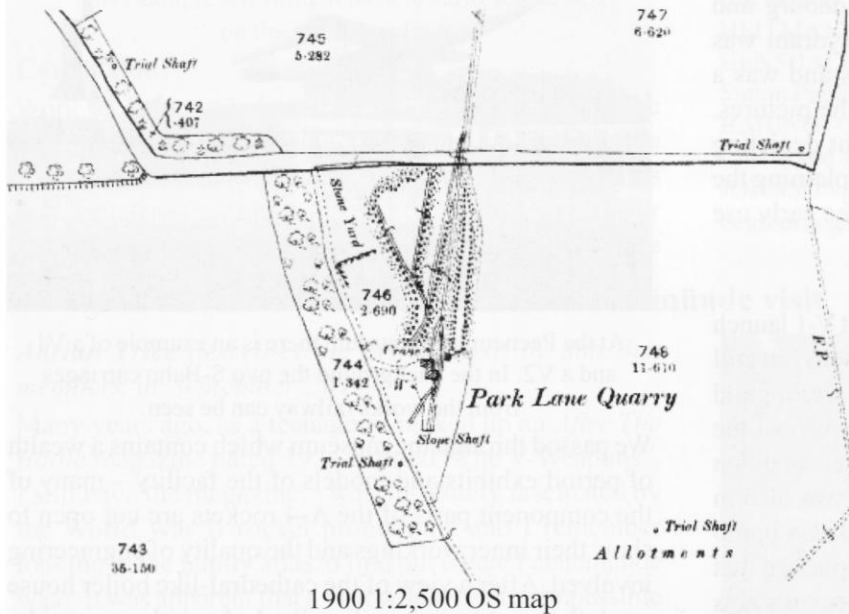
New photos by Nick Catford

The revival of Park Lane Quarry, Wiltshire

Dom Jackson

Park Lane is one of the less well-known Bath Stone quarries situated south of the village of Neston in Wiltshire. The area contains many well-known disused mines, the largest of which is the sprawling MOD complex of Burlington 1.8 miles away to the northwest, while the often visited Box mines are only 2.5 miles away. Located at Grid ref ST 871672, Park Lane is less than half a mile from the better-known Ridge mine. For many years it has remained off-limits to the casual mine explorer, the local farmer having a reputation for not being very welcoming!

The majority of stone extraction was undertaken between 1889 and 1939, when work was suspended due to the outbreak of World War II. The War Office converted several local stone mines into underground ammunition dumps, including the neighbouring mine of Eastlays. It was decided not to use Park Lane for this project and it remained in Government hands until May 1948 when quarrying started once again. Compared to the preceding fifty years of working, the next twelve years produced just over 200 feet of new passages and in early 1960 Park Lane was abandoned, and eventually sealed in 1970.



1900 1:2,500 OS map

History

First worked in 1886 by the local stone merchants Randell and Saunders, Park Lane was one of the most successful quarries in the area. Surface features comprised a winding house and single slope shaft of 200 steps with a tramway leading off toward Corsham. The slope shaft led to several roadways spreading out over an area of roughly 540,000 square feet, with over three miles of passageway.



A block of stone is being prepared for transportation to Corsham station c. 1912. The winding engine house is seen on the left. Photo Nick McCamley collection

Life underground

Horses were used extensively in Park Lane for transporting the cut stone from the working face to the bottom of the slope shaft underground, and there are the remains of several wooden cranes and trucks. As the horses spent the working week underground, only coming up into the fresh air at weekends, it was necessary to have an underground stable block. Situated close to the bottom of the slope shaft, the stables had a cobbled floor to enable easy cleaning. Just behind the stables is a well, used to provide water for men, horses, acetylene lamps and lubricating the stone saws. This well was, in late

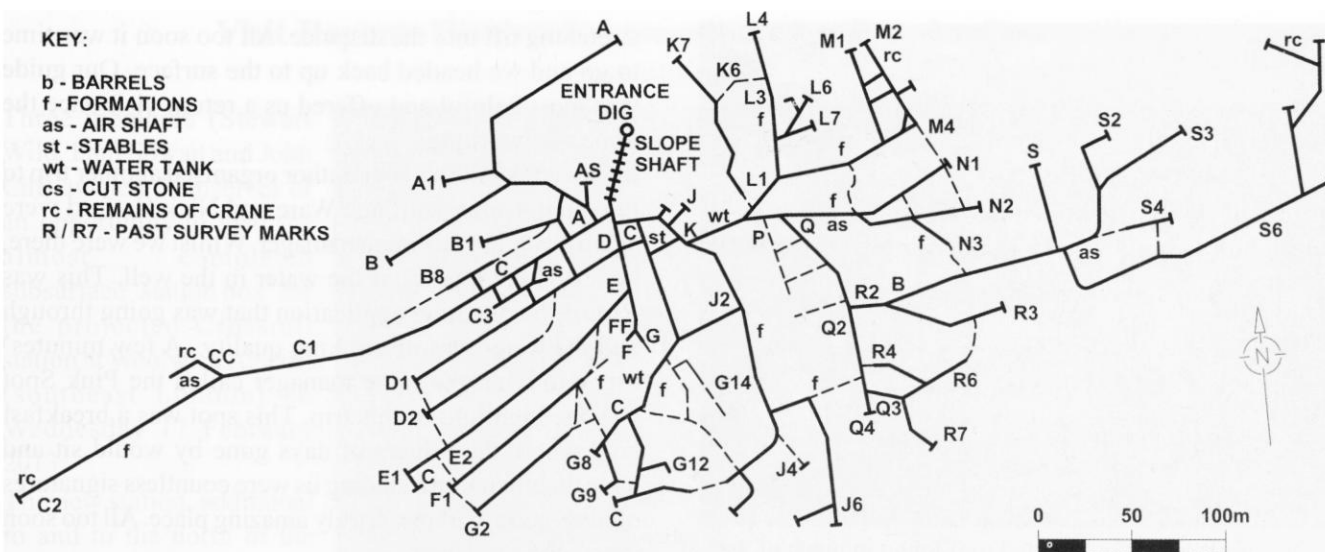
2008, still providing good-quality drinking water.



Horses at Park Lane quarry were stabled underground during the working week but at weekends they were hauled up the slope shaft to the surface.

Photo Nick McCamley collection

The most striking thing about Park Lane is the tidemarks from flooding. The mine is known to flood to a depth of approx 8-9 feet very quickly. Due to the geological make-



PARK LANE QUARRY

ORIGINAL SURVEY BY NEIL REACH & STEVE NEADS, 1990

Redrawn by Tim Robinson



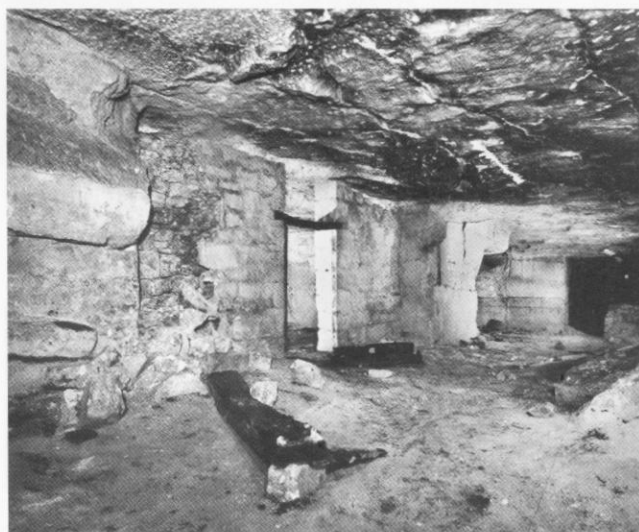
The interior of the underground stable. Note the cobbled floor to ease mucking out. Photo Nick Catford

up of the area, the bedding planes move, allowing water to flood in. But just as quickly as the water appears, it will flow away again.

Recent history

In the early 1990s, a group of local explorers gained access through the top of the bricked-up slope shaft. Very few pictures exist of this as it was before the days of digital cameras and internet forums. Even so the local farmer soon found out what was going on and was not happy with the interest in 'his' mine! Various attempts were made by explorers to gain access and these openings were filled in by the farmer time and time again. Then in May 2008 rumours began circulating of a Ridge quarry being reopened.

Pictures emerged on an underground exploration forum showing a tracked digger sat in a hole with its bucket tantalisingly covering a hole obviously leading to a slope



The entrance to the underground stable is seen on the left; there was a deep well behind the stable to provide water for the horses. The stable was sited close to the bottom of the slope shaft. G8 heading is seen to the right. Photo Nick Catford

shaft. At the time it was suspected that the mine being reopened was the Ridge quarry and rumours began to spread. A quick visit to the site confirmed that it was not Ridge but Park Lane being dug out.

The scale of the operation indicated that this was not a covert dig by mine explorers but a full-scale reopening of the mine. The online forums were going mad with rumours of who was doing it, why they were doing it and were they trying to reopen Box mines as well! A little bit of detective work provided a phone number for the mine manager and the name of the company involved, Ham and Douling Stone of Somerton, Somerset. In July 2008 a motley group of www.darkplaces.co.uk forum members gathered at the top of the newly dug slope shaft.

Our guide for the day was the mine manager. He explained what the plan was for the mine and how an investor had been found to provide the much needed



The wide span of unsupported roof found in much of the quarry indicates that large blocks of good quality stone have been removed. Photo Nick Catford



The size of the blocks removed is clearly seen in this working face. It would appear work stopped here at the end of the day and never restarted. This was, perhaps, one of the last faces to be worked in 1960. Photo Nick Catford

funding to secure the mine's future. After the Health and Safety brief, we headed off to the new steel door. Due to the interest in the mine since the new slope had been dug, large rocks and a tree had been pushed against the door. With the debris removed, we entered the mine and it was a nice feeling to be stood at the bottom of a long-sealed slope shaft. Our guide showed us round the whole mine and explained how they planned to take out the already-cut stone first. There is a huge amount of ready-cut blocks of Bath Stone sat ready to go, and it was for this reason that this mine was picked for reopening.

The whole mine is very clean and there are remains of its previous life spread around. The most striking thing about the mine is the width and length of the main passages. These were full of chog holes (chog holes are the top and bottom supports for the wooden cranes used underground) and it was an impressive sight to see these

stretching off into the distance. All too soon it was time to go and we headed back up to the surface. Our guide was most helpful and offered us a return visit once the mine was working.

In November 2008, your author organised another trip to the mine. Robin and Jane Ware and Nick Catford were again hosted by the mine manager. Whilst we were there, he tested the quality of the water in the well. This was part of the planning application that was going through and the water was of drinking quality. A few minutes' break in what the mine manager called the Pink Spot was the highlight of this trip. This spot was a breakfast hole where the miners of days gone by would sit and have their bait. Surrounding us were countless signatures of long-gone workers. A truly amazing place. All too soon it was time to leave.



There was once an extensive narrow-gauge railway network running throughout the underground workings. This short section of railway track is now all that remains.

Photo Nick Catford

Current use

Due to the complicated planning procedures involved in a project like this, it has taken until the middle of 2012 for any work to begin. Between November 2008 and July 2012 many public planning meetings were held to enable the local people to air their views. Most of the concern was about the amount of HGV movements the public were expecting.

In August 2012 the new 1.15km haul road was built using over four thousand tons of stone dug from the new stone yard to line it. Early September saw the completion of all the surface civil engineering work, and by December the engineering work surrounding the new slope shaft was almost complete. (See photo page 34)

At the time of writing (January 2013), no stone has been removed from underground and the new slope shaft has yet to be broken through. For full details see www.hamanddoultingstone.co.uk and click on 'News'.

Visit Report: Woolwich Arsenal Station Box for Crossrail

Paul W. Sowan

Three members (Stewart Wild, Paul Sowan and John Lill) availed themselves of an opportunity to visit the almost completed subsurface 'station box' for the projected Crossrail station at Woolwich Arsenal (southeast London) on Wednesday 17 February 2013.

The new station, additional to and to the north of the mainline railway and Docklands Light Railway stations already serving central Woolwich, lies within the area of the former Woolwich Arsenal. This area is being transformed with new apartment blocks interspersed between

retained Arsenal buildings, some of which have new uses including a public house (the *Dial Arch*), the Greenwich Heritage Centre, and the Royal Artillery Museum. The redeveloped area is now called Royal Arsenal Riverside. Berkeley Homes, redeveloping the site, formed a civil engineering division to undertake the Crossrail station box contract. Above the new station they will build a further apartment block.

Work at the site commenced in 2011 with the removal of the top three metres of soil and its contents, which included the foundations of former buildings and three abandoned old cannon barrels. The cannon will presumably join the other ordnance-related artefacts preserved on the former Arsenal site.

Below three metres the ground proved to be *in situ* Thanet Sand, vast quantities of which were excavated and found a ready sale as an eminently marketable commodity, with uses including golf course bunkers and packing around newly laid or replaced gas mains throughout London. The occurrence of this sand at Woolwich, an ideal moulding-sand for casting bronze cannon, has been said to be the reason why the Royal Laboratory was relocated here from Moorfields in 1715–17. It was renamed the Royal Arsenal by George III in 1805.

As the water table in this part of Woolwich lies just below the ground surface level, the station box had to be made watertight, and measures taken to prevent it from floating like a boat! Having descended some 27 metres in a scaffold ladderway, we admired the huge space, which

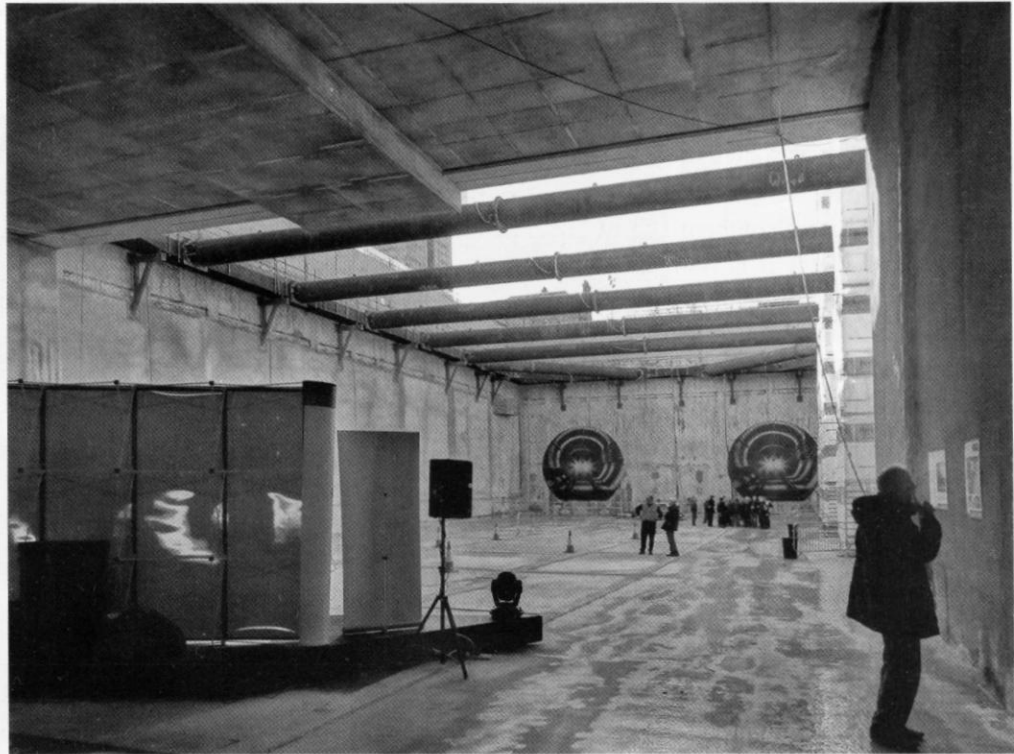


Photo Jamie Moore

when the railway is completed will house escalators, a very wide central platform, and running lines either side. Tunnel boring machines (TBMs), driving westwards from the Abbey Wood portals (on the existing rail line two stations to the east of Woolwich) at 90 to 94 metres per week, are expected to bore through the east wall of the station box, and exit by boring through the west wall, from April 2013 onwards.

The reinforced concrete box walls, a metre or so thick, have glass-fibre reinforcing where the TBMs will cut through, whereas the rest of the box has steel bar reinforcement. The two single-track bores will have to be internally pressurised to keep out groundwater, and linked to the box in such a way that the new station does not fill up with water!

Beyond the new station the two tunnels will slope downwards into waterlogged flinty chalk below the Thanet Sand and pass below the Thames en route to join the Essex branch of Crossrail, and on westwards to the western portals beyond Paddington. The new station is to have a design life of 125 years, and is flame-proofed to survive an oil tanker fire, should such a calamity ever occur.

Civil engineering at this location is assisted by pre-existing knowledge of ground conditions, the Docklands Light Railway having tunnelled under the river nearby only a few years ago. And 164 years ago the North Kent Railway arrived from the Charlton direction through several short tunnels either side of Woolwich Dockyard station.

Newcastle upon Tyne's Air-Raid Shelters

Chris Rayner

It was said of Newcastle that it had the best and the worst air-raid shelters in the country. The two shelters referred to were the Victoria Tunnel and the Ouseburn Culvert, although visiting both of them seventy years later it is not really obvious which was which.

When the WWII Government started to relax its policy on larger and deeper shelters, Newcastle was one of the handful of places mentioned as exceptions to the rule because these two sites could be brought into use quickly and with relatively little expense. These days, the Victoria Tunnel is one of the few large shelters in the country open to the public thanks to the vision of the City Council and a dedicated band of volunteers.

Coal-mining legacy

The Victoria Tunnel was originally built in 1842 as a 3.6km-long underground wagonway from the Spital Tongues colliery down to the riverside docks at Ouseburn. The coal-laden wagons would be allowed to run down to the river under gravity and would then be hauled back up empty, originally using ropes and then later with steel cables. The tunnel was lined with stone and had a brick arched head.

Its working life was punctuated with dramatic incidents, such as wagons escaping and ending up in the Tyne, and boilers exploding and killing staff. A particularly horrible incident took place when wagons were sent down the tunnel without the top men being aware that surveyors were inside the tunnel at the bottom end. When they heard the echoing rattle of the wagons, the three men in the party of surveyors made different split-second decisions – one to run, one to press himself against the wall, and the last to lie down between the tracks.

Standing in the narrow tunnel today, you can imagine their horror when they heard the clattering din of the approaching wagons. As though each had drawn a different outcome from the hat of chance, one of the men died, one was injured and one survived, unharmed.

Seven entrances

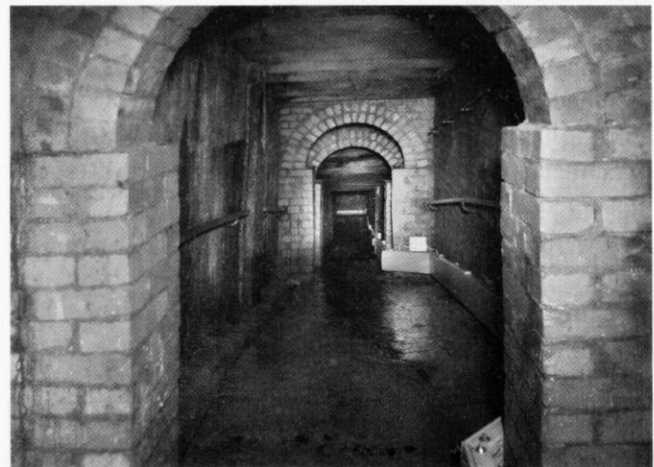
The wagonway tunnel's conversion to an air-raid shelter in 1939 cost £37,000, the bulk of which would have been



Construction of the Ouseburn culvert in 1907 – this is the lower end of the culvert beneath the Byker bridges and shows the massive scale of the project.

Photo Tyne and Wear Archives

the cost of forming new protected entrances and building internal blast walls to break the tunnel down into smaller sub-shelters. In addition, the walls were whitewashed and a tarmac-finished concrete floor was laid, and wooden benches, five hundred bunks and chemical toilets were provided.



Near the top of the ramp and stairs up to the Crawhall Road entrance, at which point the tunnel is at its deepest at 26m below the surface

The seven entrances built (at least sixteen had been planned) were at Ouse Street at the southeast end, Crawhall Road (the deepest at 26m below the surface), Shieldfield Green, Ridley Place, Barras Bridge, St Thomas' Churchyard, the Hancock Museum and

Claremont Road – all except the first requiring ramps and stairs to descend from road level down into the tunnel. The shelter capacity was given as eight thousand but it is unlikely that it ever had that many occupants. Dampness was a serious problem and a deterrent to users, although one Government inspector in 1941 observed, with the timeless insensitivity of a bureaucrat, “...better damp than dead.” He continued, “As this is a mining district, the persons who will shelter in this tunnel are possibly better fitted constitutionally to resist underground and damp conditions than those in the south.”

The tunnel was more or less forgotten postwar, and a section near the Civic Centre was converted into a sewer in the 1970s. In 1998 a 700m-long section at the southeast end was opened to visitors.



Gunnite mortar finished section of the Victoria tunnel to try and reduce water penetration.

This was found to be costly and ineffective

Starting at the bottom, one walks up the narrow dripping passage by torchlight. One can see that the whitewash was clearly intended to make the shelter seem bigger, but as the shelterers had to duck under the tunnel roof’s electric light fittings as they walked in, they probably were not fooled. The original fittings no longer exist in this section, although marks in the floor show where benches and bunks would have been, as well as the bases of Elsan toilets.

Unusual construction

The 655m-long Ouseburn culvert is very different both in terms of its cross-sectional size (at about 9m wide x 6m high) and materials (Hennebique ferro-concrete). The method of building was very different too.



Entrance showing raised floor of air raid shelter section of the Ouseburn culvert

Whereas the Victoria Tunnel was bored in shorter sections between sunken vertical shafts which were then backfilled, the Ouseburn culvert was built in the open and then covered over. This seems an odd thing to do – why build a tunnel to go through a non-existent hill that then has to be built over the top of it later?

Construction photographs from 1907 onwards show first the timber formwork and then the tunnel being built in a steep-banked valley. In a dramatic stroke of urban refacing, the inconvenient valley was filled in with industrial waste and the river tributary neatly hidden away to improve cross-city access.

In 1939 the culvert was converted into a shelter for three thousand people for £11,000. The work included the construction of a concrete platform floor a little above stream level. The finished shelter would have been incomparably drier than the Victoria Tunnel and the background sewer smell one notices today would at the time probably have been covered by other shelter aromas.



The specially raised floor of the 1940s air-raid shelter ends after 650m , and then the original lower culvert floor is exposed as seen here

The shelter's size and dryness allowed a wider range of communal facilities such as a canteen, sick bay, library, wardens' offices, a stage for musical events, a youth club and a space for church services. An unusual dispute arose between the canteen operator and the Council over his unwillingness to pay for the electricity he was using. Resolution was achieved when he agreed to lower his charges for tea and other hot drinks and sandwiches (a bargain at 1½d for tea and 2½d for the rest).

North Shields factory shelter disaster

There were many other shelters in Newcastle and Tyneside, for example shop basements and the ubiquitous street public and communal shelters.

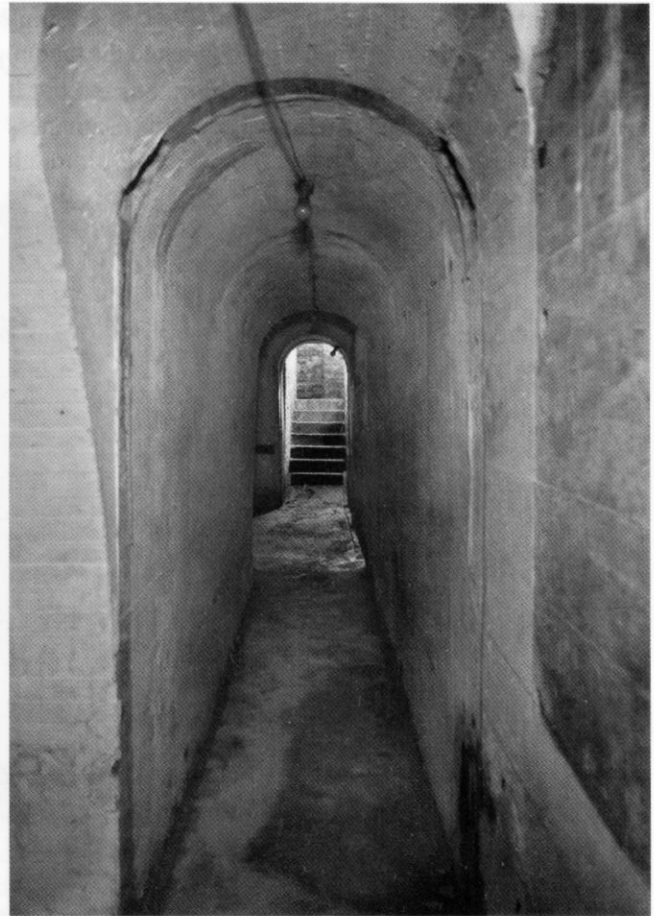
One basement shelter in North Shields was site of the northeast's worst loss of life in a single incident. An unlucky direct hit at the Wilkinson's Lemonade Factory public shelter on 3 May 1941 killed 107 people, half the total capacity of the full shelter. Of these, forty-one were children, possibly some of whom had been evacuated a year and a half earlier and then had returned home during the Phoney War period.

The shelter was in the basement under the factory which had been subdivided into three compartments, one of which was a smoking room. For unknown reasons the basement ceiling had not been strutted or reinforced, and the direct hit by a single bomb had devastating results when the heavy machinery on the factory floor above collapsed into the shelter below.

Vaulted chambers

At Jesmond Dene House a different kind of shelter survives below the 1897 Arts and Crafts transformation of an original Georgian house. The owner, Captain Noble, was part-owner of a shipbuilding and armaments business, and wanted to make the most of the house's picturesque position on a former quarry outcrop above the wooded parkland of Jesmond Dene.

Today it is a hotel of great character, and narrow winding stairs from the kitchen lead down to vaulted chambers at valley floor level where there were three entrances, now



Passage leading to base of stairs up to
Jesmond Dene House

well sealed. These cellars were probably built at the same time as the original house in the early nineteenth century, possibly as cold stores or servants' entrances and quarters.

During the war they were used by either the Home Guard who were based in the house above, or more likely as the ARP headquarters and control rooms of Newcastle, and were lined with concrete and provided with new cross connections. A strange structure built outside the valley floor entrances and described as a "pillbox" appears to have been intended to defend these entrances.

An abandoned railway tunnel at Swindon, Wiltshire

Many Subterranea Britannica members will be familiar with the main London to Bristol railway line through Swindon and Bath, and its station and nearby former Great Western Railway buildings. Rather fewer, perhaps, will know the old town on a hilltop to the south, or will know that Swindon once had a second railway, running north-south, with its own station the far side of the old town. This was the Midland and South Western Junction Railway, and was to have joined the Midland Railway at Cheltenham to the London & South Western Railway at Andover, thus completing a through route from the Midlands to Southampton. The line opened in 1881 and had stations at, amongst other places, Cirencester, Cricklade, Marlborough and Ludgershall. Short tunnels were successfully driven at Chedworth and Marlborough.

But an intended 773-yard tunnel under Swindon's old town, commenced in October 1875, was abandoned a year later as the contractor encountered too many problems with the geology. The line was taken around the town on the west side instead. So an unfinished tunnel lies underneath Swindon's old town. The blocked northern portal lies in a park. Your correspondent (PWS) found no trace of a southern portal location, or of any spoil extraction shafts, when he explored the town some years ago. Some details, including a map and section of the intended tunnel, can be found in the booklet below cited. SOURCE: BARRETT, David, Brian BRIDGEMAN, and Denis BIRD, 1981, *A M. & S.W.J.R. album: a pictorial history of the Midland and South Western Junction Railway. Volume 1. 1872 — 1899* Swindon: Redbrick Publishing: 86pp [ISBN 0-9507182-7-X]



Demolition at Peenemünde has been so thorough that little survives apart from a little concrete and overgrown rubble from demolished buildings. At the site of Test Stand 7 and original fire hydrant can be seen. Robin Ware is holding an old photograph of the same site. Note the V2 nose cone behind the hydrant. A memorial is seen to the right. Photo Nick Catford



Demolition of the London West AAOR at RAF Uxbridge is underway in November 2012. Photo Paul Francis



Metal water tank in K drive, close to the stable, in Park Lane Quarry. The corrugated sheeting suspended from the roof collects water which is fed into the tank. Park Lane required water for the horses. Photo Nick Catford



The new slope shaft into Park Lane Quarry, Corsham in late March 2013. Photo Dom Jackson



Metropolitan Locomotive No 1 stands at Baker Street station during the 150th anniversary of the Met celebrations in January 2013. Photo Robert Davidson



Reinforced section of Ouseburn culvert in Newcastle upon Tyne. The culvert was used as a public air-raid shelter during WWII. Photo Chris Rayner



London Road mine: this view is from October 1984 before backfilling commenced. What looks like narrow-gauge railway track may in fact be support for an asphalt or cement surfaced walkway. The opening on the right leads to a lower level. Photo Nick Catford



Reigate Lodge North mine in June 1986: mining on two levels separated by an iron-cemented 'carstone' band can be seen. Photo Nick Catford



London Road mine in August 1987: backfilling in progress. The height and roof-span of this part of the mine can be appreciated (the conveyor belt is two to three feet wide. Photo Nick Catford.

Industrial-scale silver-sand mining at Reigate, Surrey

Paul W. Sowan

Reigate, the oldest and largest town in east Surrey, is in parts undermined. An estimated 45,000 cubic metres of sand has been excavated from below its streets, buildings and open spaces. The same is true of parts of adjoining towns and villages from Dorking eastwards to Godstone. Industrial-scale mining, and underground quarrying, has taken place at shallow depths at numerous locations in this 20-kilometre-long stretch of the outcrops of the Upper and Lower Greensand beds flanking the so-called Vale of Holmesdale, or Gault Clay vale.

Taken together with the Chalk of the North Downs ridge, lying alongside and to the north of this mining field, this district has been an important source of minerals for London from Roman times onwards. Silver-sand (high purity silica sand) for glass-making is still worked on a large scale today from opencast pits alongside the A25 at Buckland and near Godstone.

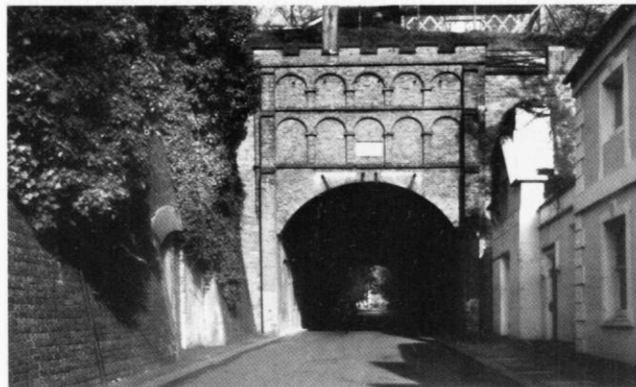
The strata and their economic products of this intensively mined and quarried district, in stratigraphical order, are as follows:

Geological stratum	Rock bed	How worked	Applications
Chalk	White Chalk	Opencast	Agricultural, building and chemical applications
Chalk	Grey Chalk	Opencast	Hydraulic lime for building
Upper Greensand	Reigate stone	Underground	Building-stone
Upper Greensand	Firestone	Underground	Refractory stone
Upper Greensand	Hearthstone	Underground	Mineral pigment
Gault Clay	Gault Clay	Opencast	Bricks and tiles
Lower Greensand	Folkestone Sand	Underground and opencast	Glass-sand, building sand &c
Lower Greensand	Sandgate Beds (fullers' earth)	Underground and opencast	Various specialist applications
Lower Greensand	Sandgate Beds (quoin stone)	Opencast	Building-stone
Lower Greensand	Hythe Beds	Opencast	Road metal
Lower Greensand	Atherfield Clay	Opencast	Bricks and tiles

Reasons for the intensity of mineral extraction in east Surrey

This district has been so intensively mined and quarried for a combination of geological and economic reasons. The outcrops of all the geological strata listed above are, at and around Merstham (east of Reigate), at their closest approach to London, the primary market for most of the mineral products. And two of the exploited lithologies, in the Upper Greensand and the Lower Greensand Sandgate Beds, are exceptionally unusual rock-types.

Reigate stone has a unique mineral composition amongst British building-stones, which historically made it very much favoured for fine ashlar and freestone work during



Tunnel Road: south portal of England's earliest surviving road tunnel. The inscription above the tunnel portal reads: 'THIS PRIVATE ROAD WAS FORMED THROUGH THE PRIVATE GROUNDS OF THE RIGHT HONOURABLE JOHN SOMMERS EARL SOMMERS IN THE YEAR MDCCCXXIII. On the left can be seen the entrance to a part of the Market mine used early in the 20th century as a bicycle shop. The building on the right fronts the Tunnel Vaults, these words appearing on it. Doorways within the tunnel lead to the East and West mines. Photo December 1986: Nick Catford

the Middle Ages. And fullers' earth, whilst a relatively common mineral species, rarely occurs in beds thick enough to be worked economically (other British fullers' earth extraction has been at, principally, Maidstone in Kent, Woburn (Bedfordshire), and south of Bath in Somerset). Added to these considerations, greystone lime and high quality silver-sand suitable for glass-making occur no closer to London than Merstham and Reigate. It is a very curious geological coincidence that two distinctly unusual rock-

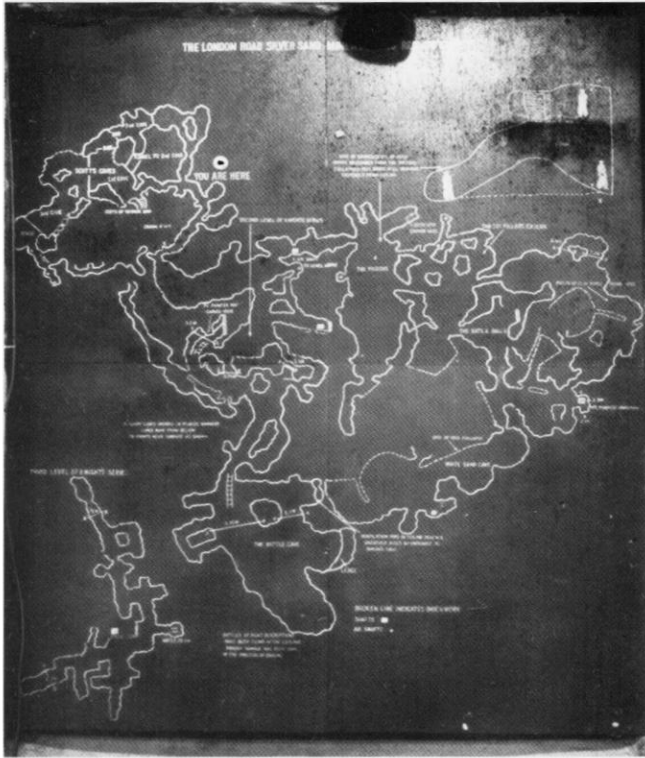
types have been deposited in economically workable thicknesses in one and the same district, the fullers' earth well over 100 million years ago, and the Upper Greensand some millions of years later.

Geographical and economic difficulty: North Downs a barrier to heavy freight traffic

Many of the mineral resources listed were being taken to London long before the reintroduction (after the end of the Roman occupation of Britain) of paved roads in the 18th and 19th centuries, or the creation of river navigations, canals and railways.

Reigate lies at the foot of the North Downs chalk escarpment, which rises behind the town to over 235

metres above sea level. There are no river gaps through this range of hills between that of the Mole at Dorking and that of the Darent (Kent) north of Sevenoaks, making the transport of heavy mineral traffic to London problematic. During the Roman period, and later, iron smelted from ore dug in the Weald was conveyed to London probably along the Roman road through Godstone and its wind-gap through the North Downs. Another Roman road (Stane Street) was routed through Dorking and the Mole Gap.



London Road mine: this sketch plan of part of the three-dimensional mine complex was once displayed in an underground bar in 'Scutt's cave'. A copy is now displayed in the Barons' Cave in Reigate Castle grounds.

Photo Nick Catford

How important the Merstham wind-gap was as a route for heavy goods traffic, where no trace of a Roman road has ever been reported, is problematic: however, Reigate stone was undoubtedly used in London. Before the days of improved (turnpike) roads, canals, and railways, overland transport for bulky heavy goods such as stone was expensive, the price of Reigate stone for example being estimated to be doubled after twelve miles of carriage, or more or less trebled by delivery in London.

Surrey and the glass industry

The importance of Surrey in British glass-making falls into two quite distinct periods. In the first phase during the Middle Ages, high purity sands found in and around Chiddingfold in southwest Surrey were used, along with plant-derived potash, to make fine glassware. The high-value products, small and light and portable (albeit fragile), could be taken to London (well packed) on horseback. Woodlands provided the necessary fuel, and crucibles were used to make the small volumes of glass produced.

It has been reported (Crossley) that 45 of the 80 known British glasshouses in the period 1250 to 1600 were in southwest Surrey. This industry ceased in or about 1620 as a result of statute law, it being enacted that no further woodlands should be destroyed for firing furnaces: timber for shipbuilding, especially for the navy, was a higher priority.

The focus of glassmaking in southeast England then moved to the banks of the lower Thames, where the necessary raw materials and fuel (now coal) could all be imported by ship. Although Thanet Sand could readily be found at, for example, Charlton and Woolwich on the south bank of the river, this was suitable only for poor-quality bottle glass. It was more useful as foundry sand, especially at Woolwich for casting cannon.

High-quality glass-sand could be and was imported cheaply by sea from British coastal deposits and from Belgium and France. The cost of overland transport of sand from the Reigate district probably precluded it from use until the improvement of a paved road via Reigate Hill and Sutton in the middle 1750s. It is likely that the industrial-scale mining of sand at Reigate postdates that road improvement.



Reigate Lodge North mine: this is the main gallery. A steep scramble via an accidental connection on the right-hand-side leads to the higher-level South mine.

Photo June 1986: Nick Catford

Technical requirements for glass-sands

'The ideal sand for the best glass-making,' according to Boswell (1919), 'is one with 100 per cent silica and composed of angular grains all of the same size, and of the grade known as medium or fine sand. Such a perfect sand has not at present been discovered, but the ideal is approached by a few sands, including those of Fontainebleau in France (99.7 per cent silica) ... Several British sands also closely approach this ideal.'

In terms of uniformity of grain size, sand from King's Lynn (Norfolk) is excellent, with the great majority of grains slightly less than 0.5mm in diameter. For the best

clear glass, iron and chromium concentrations should be below 0.1%. The 'medium' grade sand recorded by Gossling at Reigate falls within the 0.25 to 0.5 mm grain diameter fraction. Fontainebleau is near the river Seine, about 53 km south-southeast of Paris.

Discovery and exploitation of silver-sand at Reigate

Those who dug the dry moat around the western and northern sides of Reigate castle, by all accounts in the eleventh century, cannot fail to have noted the very white sand (silver-sand) in doing so. Likewise those who excavated the Barons' Cave, at some time before 1586, when it was first described in print (Camden). Translated from Latin into English at the time, this has been rendered as:

On the East side, standeth a castle mounted aloft, nor forlorne and for age readie to fall; built by the same Earls of the vale wherein it standeth, commonlie called Holmescastell; under which I saw a wonderfull vault carried under the ground of arch-works over head, hollowed with great labour out of a soft gritte and crumbling stone, such as the whole hill standeth of.

A legal document of 1589–90 (Moorer and Moorer) referred to 'a parcel of land and adjoining cave' at or near the castle: whether the Barons' Cave or not cannot be sure. And a survey in 1623 referred to 'a quantity of special white sand within the Lord's castle'.

Local documentation for industrial-scale sand mining in Reigate is virtually non-existent: an extraordinary circumstance for a town centre as noted for subsurface cavities as is central Nottingham. However there are records confirming Reigate's position in the trade.

Robert Hunt (1860) throws some light on the British glass-sand industry as it was in 1858, for example. In that year, sand suitable for glass-making was obtainable from Aylesbury Heath (Bucks); Wareham (Dorset); the New Forest (Hampshire); Alum Bay and Yarmouth (Isle of Wight); Bearstead, Hollingbourne, Aylesford and Tunbridge Wells (Kent); Wansford, Apethorpe, Blatherwyke, Burleigh, and Caswick (Lincs, Rutland and Northants); King's Lynn (Norfolk); Reigate (Surrey); and Hastings (Sussex). A number of these sources could well have supplied London via coastal shipping more cheaply than inland Reigate.

Hunt says of Reigate:

Sands of various kinds are sent from this district, to the extent of 20 tons of 20 bushels to the ton per week, at 5s. per ton, or 1,040 tons per ann., of the value of £ 260.

Presumably the prices quoted are as at Reigate, not as delivered in London.

A footnote relating to the Kent entries informs us that:

For some years past a large proportion of the glass-house sand used in this county has been obtained from Fontainebleau; the price in the River Thames being about 22s. per ton.

Similar but less detailed information was also reported by Hunt for 1856, in which the Hastings source is

specified as the East Cliff. Nothing of consequence concerning Reigate sand is to be found in Hunt's *Mining Records* for earlier or later years, which are largely concerned with metalliferous ores, coal, and associated minerals.



London Road mine: what appeared to be light narrow-gauge railway track could be seen in near-surface parts of this mine. It has been suggested that this was laid in connection with World War I military storage.

Photo May 1987: Nick Catford

Surrey firestone for glass furnaces

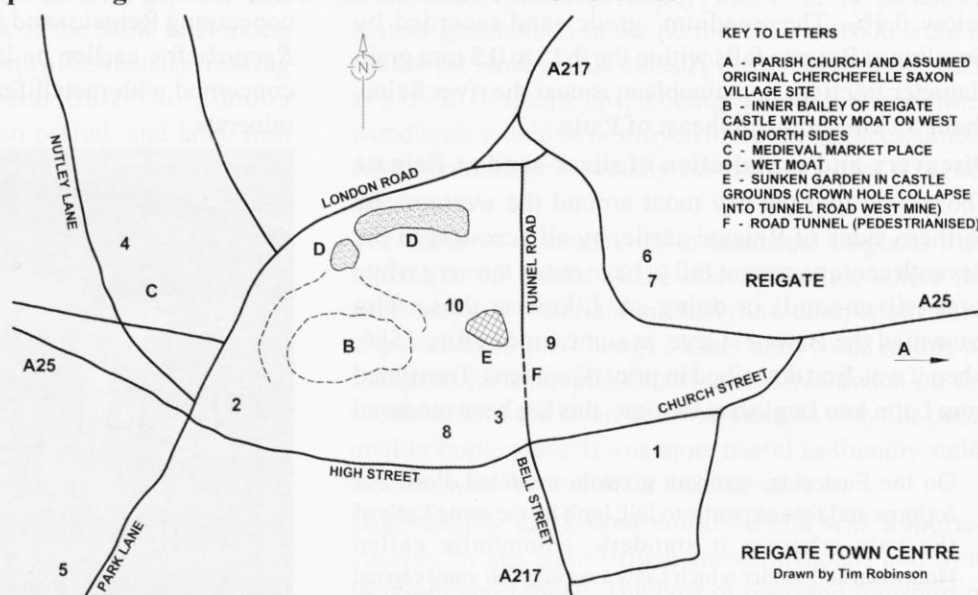
It is a curious fact that east Surrey reportedly had a further role in the British glass-making industry, beyond the supply of sand. This was the supply of refractory stone, quarried from the Upper Greensand, for use in glass-houses (that is, glass furnaces). James Malcolm (1805) recorded that:

In the parishes of Godstone and Reigate, stone is found in great abundance. The quarries have been worked for many years; but the quality of the stone being of a soft tender nature, is principally used as common fire-stone, and about London is sold at 1s. 6d. per foot cube. In the parish of Bletchingly, at a place called White Hills, a species of stone is found superior to any yet known in England, and equal to any that is found in Europe, for the purposes of the glass manufactory. In its nature it is softer and more easily worked, but requires more caution in working than either of the other two. It is of such a peculiarly fine quality for sustaining the utmost heat, that it is sought after by all the principal glass manufacturers in every part of the kingdom; large quantities being now shipped for Liverpool and the north. It was principally owing to the powerful effects of this stone, which became known to Mr. Dawson, the original proprietor of the Vauxhall plate glass works, that he was enabled to produce such amazing plates as not only to give his glass a decided preference in England, but to astonish even the French themselves, from whom Mr. Dawson discovered the secret of manufacturing plate glass in the garb of a day labourer. Notwithstanding however the stone is not naturally possessed of such an incredible power, a great deal depends upon the manner of building the furnace. Trial after trial has only served to prove that the projectors knew but little of the business; Frenchmen

Map of Reigate town-centre mines and related features

Mines

- [1] Church Street
- [2] London Road
- [3] Market
- [4] Nutley Hall
- [5] Park Lane
- [6] Reigate Lodge North
- [7] Reigate Lodge South
- [8] Samaritans
- [9] Tunnel Road East
- [10] Tunnel Road West



have been sent for, but with as little success; and the Albion plate proprietors, like others of the same profession, after sinking immense sums in erecting works, must have given up the concern altogether, but for the very extraordinary abilities of Mr. Samuel Atkins, of Vauxhall, who was formerly a stone-mason, but who has retired from business. Possessed of great natural talents, quick in conception, and of extra-ordinary activity in execution, he traced out the art when a boy, and matured it into system in his riper years. I am informed that those manufacturers, who have employed him, can now make plates nearly one-third larger than they could before. These stones are fortunately procured of almost every dimension, some containing not less than 72 feet superficial, of 10 inches thick; such stones are sold at 3s. 6d. per foot, delivered in London; the more ordinary sizes at £3 10s. to £4 per load of 102 feet.

A slab of stone measuring eight by nine feet, and ten inches thick, would be a daunting load to manoeuvre out of the quarry tunnels and over the hills to the Thames at London from whence it could have been shipped to Liverpool. Whilst some of Malcolm's details in this passage are probably recycled from earlier published sources, the specific dimensions cited in the final sentence appear to be direct from local information. However, no independent supporting sources have yet been traced.

Other authors also mention the use of the stone in glass-houses, although in exactly what capacity is not clear. All glass through to the nineteenth century was melted in refractory clay crucibles, not in contact with stone slabs of any description. Indeed, the composition of the Upper Greensand is such (largely very fine-grained silica with a significant subsidiary calcite content) that this would not be a satisfactory refractory at the temperature of melted glass. It would probably itself melt, or dissolve in or react with the charge. The stone slabs may have been used in the lower-temperature annealing furnaces, or as casting tables for making flattened sheet glass. I have to date seen no Surrey stone reported as such from excavated glass furnace sites in London.

Reigate and its silver-sand mines and related features

Notes to the map

Reigate (called Cherchefelle until after the Norman Conquest) appears to have commenced as a Saxon village close to the parish church, some distance to the east of the town centre.

After the Conquest of 1066 the Normans built a castle, of which only the earthworks now remain visible at surface, and perhaps the so-called Barons' Cave below the inner bailey. A new town, now called Reigate, developed on the south and west sides of the castle.

Nutley Lane was an original road northwards from Reigate. Its northern extension up the chalk escarpment at Colley Hill, originally Kingston Hill, appears to have been the route taken by loads of stone from the Reigate quarries in the Reigate Hill area to the Thames at Kingston, but is not now and possibly never has been a road suitable for wheeled vehicles.

Turnpike roads reached Reigate

- (1) In 1679 from Crawley
- (2) By 1755 from Sutton
- (3) In 1808 from Croydon via Merstham

The road (now A217) from London via Sutton was greatly improved by civil engineering work on Reigate Hill in the middle 1750s.

The Croydon, Merstham & Godstone Iron Railway, a horse-drawn freight-only line, was authorised by Act of Parliament in 1803 to be built to a terminus on the east side of Bell Street, but in fact was built from Croydon only as far as Merstham, this part being completed in 1805.

Traffic from London to Reigate and further south was, until about 1824, via Reigate Hill, London Road around the west end of the castle, and thence southwards via Bell Street (A217)

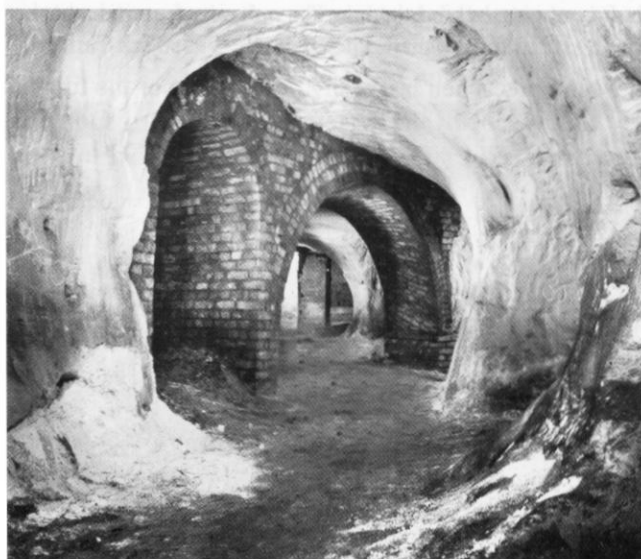
In the early 1820s Tunnel Road was driven below the east end of the castle, including what is now recognised to be England's oldest surviving road tunnel. It was in effect another turnpike or toll road, charging tolls to those wishing to take this short cut. This gave Reigate its first central crossroads, but is now pedestrianised.

The Reading, Guildford & Reigate Railway, for conventional locomotive-hauled goods and passenger trains, was opened with a station at Reigate (on the A217 north of the town centre) in 1849, connecting with the London to Brighton line (which had been opened in 1841) at what is now Redhill.

The one-way system around Reigate was completed by the construction in the first years of the twentieth century of Castlefield Road built, in part, to serve the new (and present) town hall.

Notes on the Reigate mines

[1] Church Street: a very small craft-scale mine below the road, with an entrance by steps down from premises on the south side side, now completely backfilled.



Church Street mine: this small mine under the road was entered via D.H. Croft's electrical shop on the south side of the road. Note the heavily built support, and the damaged pillar on the left exposing high quality silver-sand.

Photo December 1987: Nick Catford

[2] London Road: a complex series of irregular excavations on several levels partly below London Road, the *Red Cross* public house and adjoining premises (some now demolished) with at least one internal vertical shaft. Access was from within the now demolished premises, at least one of which was a public house. These were possibly the oldest industrial-scale mines in the town, but have now been largely backfilled, other than a small section which is still accessible by permission of a commercial proprietor. The lowest levels were well below the level of London Road, and indeed appear to have reached the local water table, as there was often standing water.



London Road mine: this view illustrates the high extraction ratio obtaining at this site, well below 25% of the rock being left in-situ to support the roof. A great deal of introduced or run-in soil and building rubble can be noted. Eighteenth-century and earlier pottery has been reported, although nothing has been satisfactorily archaeologically recorded because during a lengthy period when there was unrestricted access collectors of Victorian and earlier bottles dug extensively for additions to their collections. Clay tobacco pipes dated to the period 1730 – 1780 have also been reported.

Photo August 1987: Nick Catford



London Road mine: silver-sand extraction on two levels can be seen here, separated by a hard band of iron-cemented sandstone. Where this material, called 'carstone' or 'brown flint', has been taken out of the mine it has been used in and around the Reigate Castle grounds for hard-wearing surfaces for footpaths and steps. Qualities of sand from pure white to heavily iron-stained can be seen. The whitest material would have made clear glass. Depending on the iron content, lesser grades would have been suitable for making brown or green beer bottles, or as builders' sand.

Photo October 1984: Nick Catford

A spectacular roof failure in 1860 was illustrated and briefly described in the *Illustrated London News*. The back walls and back gardens of a row of cottages collapsed into the void, although no personal injury or loss of life was recorded.

The infilled parts of this mine, which underlie the Castle Grounds (and also in part underlie the Barons' Cave), form an integral part of the Reigate Castle Scheduled Ancient Monument.

[3] Market Caves: an irregular series of small tunnels with floors at about street level, having an entrance at the rear of the *Market* public house, to which they belong. There is also a locked entrance on Tunnel Road, which formerly gave access to an underground bicycle shop. These 'caves' were until recently full of modern junk, which has now been removed. They communicate with an iron grill within the road tunnel which incorporates the wording 'Mead's wine & beer stores'. Charles Mead advertised as a 'family wine, spirit and beer merchant' at the market place (at the south end of Tunnel Road) in 1885.

The Market Caves once connected, via a 16 feet (5 metres) drop, with the former lower-level Constitutional Club Cave: the connection and the cave are now back-filled, as is a former connection to Tunnel Road West mine.



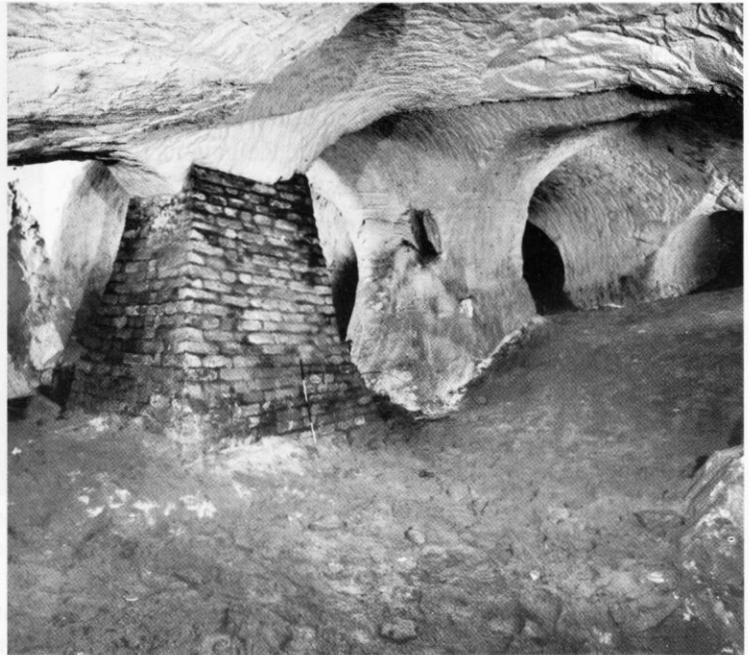
Market mine: this series of tunnels is accessed from the rear of the Market public house on the corner of High Street and Tunnel Road. It communicates with an area on the west side of the road tunnel wall, where a cast-iron grille can be seen, lettered 'Mead's wine & beer stores'. Charles Mead advertised as a 'family wine, spirit and beer merchant' at the Market Place (east end of the High Street) in 1885.

Note the brick and slate provision for storage.

Photo June 1996: Nick Catford

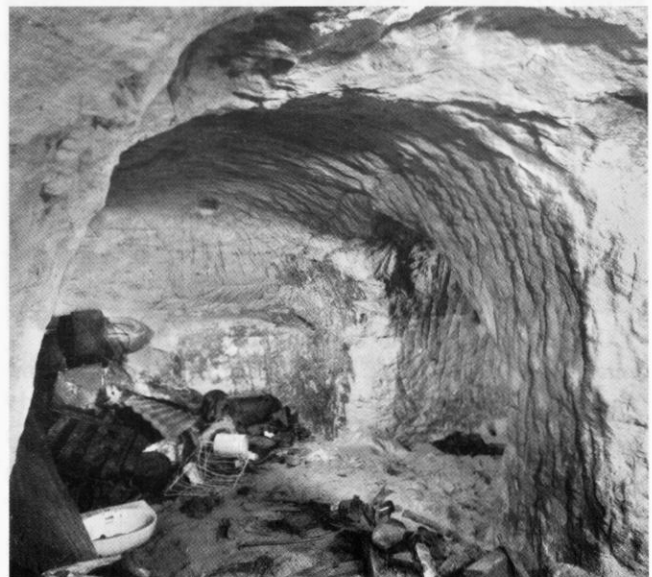
[4] Nutley Hall: a small pillar-and-stall sand mine below the former *Nutley Hall* public house, entered by a rock-cut stairway from within the premises, where there is also a vertical shaft access. When last visited by the author it was observed to have been used for disposing of rubbish via the shaft.

[5] Park Lane: a very small set of mined tunnels with an entrance from a low cliff within a former open



Nutley Hall mine: this small pillar-and-stall mine lies below and was entered from the former public house, a rock-cut staircase and a vertical shaft emerging behind the bar. The pub sign featured a basket of sand being lifted from a shaft. Photo March 1997: Nick Catford

sand pit. When last visited by the author the tunnels were seen to have been used for the disposal of rubbish. The site now falls within modern residential development. This is possibly the last mine worked, for the five years 1896–1900.



Park Lane mine: this small mine is thought to be the last one in Reigate mined for sand, in and about 1900.

Photo January 1985: Nick Catford

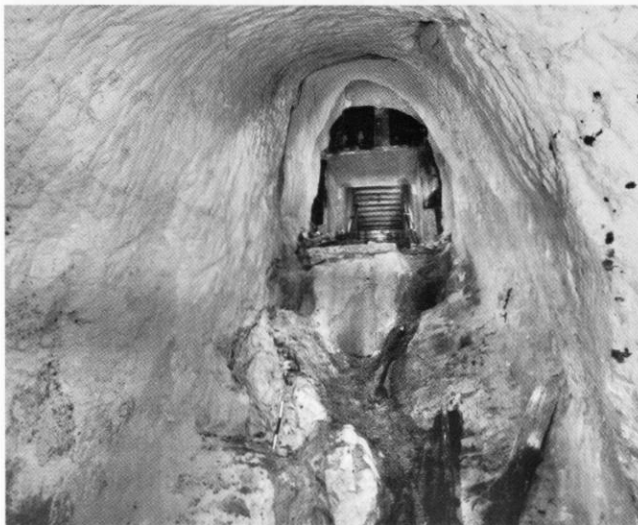
[6] Reigate Lodge North: a spacious mine of small extent but with two wide and high main passages, and some smaller side passages. Entrance is still possible via a wide deep vertical shaft (there is no ladder in place). During World War II two entrances (now blocked) and short timber staircases were provided on the north side for access for air-raid

shelter purposes by the then adjoining school. This mine connects at one point with the higher-level Reigate Lodge South mine.



Reigate Lodge North mine: this impressively spacious mine tunnel (and the whole Reigate Lodge complex) is currently accessible only via a wide, deep vertical shaft which enters via the ceiling. At the far end only the right hand side of the gallery has been excavated. The scale bar is 21 inches.

Photo June 1986: Nick Catford



Reigate Lodge North mine: this view is towards what remains of one of the two timber air-raid shelter access stairways installed during World War II. Girls from the nearby school sheltered here during air raids.

Both entrances are now sealed. Gullying and surface soil have resulted from water ingress.

Photo April 1996: Nick Catford

[7] Reigate Lodge South: a small mine formed as a small grid of low narrow passages with 'Gothic arch' ceiling profiles, originally accessed via a vertical shaft (now blocked). The floor level of this mine is higher than that of Reigate Lodge North, with which it is connected. There is a single steep 'scrambling' connection between the two.

[8] Samaritans Cave: a small space, more in the nature of a rock-cut cellar than a mine, at the rear of the Samaritans' premises.



Tunnel Road East mine: this north-south inverted V profile tunnel ceiling, along with built-brick support, suggest a joint or line of weakness in the rock. Clearly the miners has experienced 'overbreak' in this area, more sand having fallen from the ceiling than was intended.

Photo April 1996: Nick Catford

[9] Tunnel Road East: a rectilinear grid of relatively low mined passages accessed from within the road tunnel, currently occupied under licence from Reigate & Banstead Borough Council by the Wealden Cave & Mine Society, housing a developing museum and a series of displays relating to east Surrey's former mineral industries, and to World War II and Cold War shelter uses. Much of the interior is brick-lined, and / or has built-brick roof-support arches. Where visible, the sand walls exhibit interesting geological features such as silt-filled near-vertical joints, and colourful iron-staining patterns. The Ordnance Survey plan of Reigate of 1872 indicates three former vertical shafts from (then) open land above. These are now back-filled, as are parts of the mine tunnels with which they communicated. Changes of the interior floor level suggest that this mine originated as a shaft-worked mine, extended westwards to connect with the road tunnel when that was driven in the early 1820s.

The interior has been greatly modified as a result of secondary uses including military storage in World War I, possibly beer storage, World War II air-raid shelter and control centre provision, and Council storage. There were also public toilets (now closed) built into parts adjoining the road tunnel. Wartime shelter toilets (not now functional) also survive, as do two large concrete water storage tanks. At two or three points there is built wall-lining made of roughly squared chalk blocks, rather than the expected Reigate Stone: these may have been reused from a former Reigate building, as chalk has been recorded as a building material in internal work and cellars in the town.

Severely worn built-brick protection on some pillar corners suggests that heavy goods (whether beer barrels or military stores) have been moved around on low trolleys at some time.



Tunnel Road East mine: World War II era ladies' toilets.

Photo April 1996: Nick Catford

On the southern boundary a reinforced concrete wall has been built presumably to protect the adjoining Tunnel Road Vaults (wine cellars) from unauthorised access: the intervening in-situ sand is in places only around a metre thick. At one point a rectangular hole has been cut through this barrier (from the mine), this being currently the only access to the vaults, former entrances from adjoining premises and from Tunnel Road having been sealed. This hole had been made by 1939, as it appears (marked 'emergency exit') on a plan for conversion of the mine for air-raid shelter use. There is a more realistic emergency exit to Tunnel Road, clearly dating from World War II, at the northwest corner of the mine. Access to this mine is by arrangement with the Wealden Cave & Mine Society (www.wcms.org.uk) who organise public guided tours on the second Saturday of each month from May to September. The Tunnel Vaults, fitted with slate-shelf wine bins and defunct gas-lighting fittings, were clearly excavated for that purpose, and contain numerous empty bottles (all of relatively modern date).

The floor of Tunnel Road East slopes gently downwards to the north, whereas Tunnel Road slopes upwards in the same direction. For this reason the wartime emergency exit has an approximately two-metre high flight of steps inside the mine.

There is no underground connection, below Tunnel Road, to Tunnel Road West mine, and probably never was.

[10] Tunnel Road West: an extensive mine comprising tunnels up to four metres wide and five metres high from floor to ceiling. The space is now occupied by a rifle club, but that body kindly allows access to guided public tours organised (see above) by the Wealden Cave & Mine Society. The centre of the mined area, walled off, is the site of the 1858 roof-fall. Access remains to most of the mine surrounding this area.

Much of the floor is several (up to seven or eight) metres below the level of Tunnel Road. Speculation that the



Tunnel Road Vaults: these purpose-built rock-cut vaults and brick and slate wine bins adjoin Tunnel Road East mine on its southern boundary. A substantial reinforced concrete slab has been built up against the southern boundary within the mine, presumably to prevent unauthorised access to the stored wine as the intervening soft sandstone is in places only about a metre thick. As original entrances to the vaults from adjoining premises and Tunnel Road have been bricked-up, the only current access is from the mine via a hole cut through the concrete slab! Cold chisel marks indicate the hole was cut from the mine, not from the vaults.

A surviving 1939 plan showing intended allocation of spaces within the mine for air-raid shelter and allied uses indicates the hole in the wall to be an 'emergency exit' although on account of its shape and size and the thickness of the wall this is a very awkward scramble to negotiate.

All the relatively modern wine bottles are empty (the author has checked), and many are broken.

Photo December 1986: Nick Catford

east and west mines formed a single large excavation before 1820, through which the road tunnel was subsequently driven, can be discounted. The mine floor levels and plans either side of the road do not match.

It is difficult to see how sand from the deep-lying northern and western parts of the mine could have been conveniently raised to road level within the tunnel. It may be that this mine was commenced and serviced by a vertical shaft: the only feasible location for such a point of access would have been within the collapsed area. No direct evidence for or against this possibility is known.

Access to the former Constitutional Club Cave (see Market Caves above) has been blocked by backfilling and walled off. Access to the westernmost part of the mine (not used by the rifle club) is now by way of a new eight-metre tunnel bored in or about 1987, as a result of a less convenient access route being backfilled at that time.

The parts of the mine closer to Tunnel Road have been re-engineered, especially during World War II, when two access points for air-raid shelter purposes,



Tunnel Road West mine: this is a north-south view within the spacious pillar-and-stall mined area at the western extremity of the mine, where the galleries are up to 12 feet (four metres) wide and 16 feet (five metres) high. In this area much of the floor is hidden below about three feet (one metre) of (mostly) broken glass bottles. An east-west view through this same area shows a contrasting gallery profile, indicative of an east-west alignment of weakness.

Photo September 1987: Nick Catford



This nine-yard new tunnel was made in or about 1987 to retain access to the western end of the mine, an alternative route having been backfilled.

Photo March 2013: Nick Catford

equipped with wooden stairs (long-since rotted and cleared away), were provided. There are also modifications made for their own convenience over some decades by the rifle club. World War II-era graffiti (names and dates, and a depiction of Adolf Hitler) can be found scratched on the walls. A single brick pillar has been built to support the very small area (pavement) of Tunnel Road to pass above the void. The remains of a wartime poster remind shelterers of the need to have their gas masks with them.

Beyond the 'new tunnel' of about 1987 the mine is largely unchanged, other than the insertion of brick supports at two or three points, and the presence of about a metre depth of mostly broken glass bottles covering much of the floor. In 2003 the author and others, with Scheduled Monument Consent, excavated an area between two mine pillars, establishing this fact. No



View south along the up sloping access tunnel running parallel with the road tunnel.

Photo March 2013: Nick Catford

artefacts relating to mining were found, in fact nothing earlier than about 1900. The material seemed partly to be domestic refuse (jars and bottles bearing the names of several local firms and Mellersh & Neale's brewery) and partly dumped bottles from the time this cave was used for beer and wine storage. The impression given is that this material was cleared from the front of the system during the conversion to shelter accommodation. The oldest graffiti, very carefully cut as large letters and figures, is found in the westernmost end of the mine, and reads HAA 1862.



The hand rail for a former timber stairway can be seen here; the bricked-up entrance to which it led is in the Tunnel Road northern cutting, beyond the north portal and dates from WWII when Tunnel Road West was used as an air-raid shelter.

Photo March 2013: Nick Catford

Pick-marks on the walls and ceilings suggest that here, as in all the mines, excavation was done with picks. The very high galleries, and the presence of two 'miners' benches', suggest that the tunnels were excavated first at what is now ceiling height, and then progressively deepened in a series of 'lifts' of about a metre each. A scored pillar corner at one point suggests wheelbarrows were used to move sand within the line.

The whole of this mine forms an integral part of the Reigate Castle Scheduled Ancient Monument.

[11] Reigate road tunnel (and cutting): the creation of this substantial steep-sided road cutting and amply proportioned tunnel in the years 1820–24 clearly resulted in the excavation of a considerable volume of sand which, presumably, was sold. This may of course have effectively undercut the profits of sand mines operating at the time, although conceivably established sand-miners were employed to do the work. The proceeds of the sale of the sand, and the tolls charged to persons using the new Tunnel Road, were perhaps taken into account in off-setting the costs of making the new highway. In any event, the cutting and tunnel can be considered to have been a mine in its own right. That this is a true bored tunnel, not a cut-and-cover structure, is shown by two water-colours by John Hassell, which depict the rock-cut tunnel completed from end to end but not yet brick-lined. The notebooks of William Constable, who supervised the work, indicate that he purchased augurs, suggesting that he saw a need to probe ahead for unknown cavities while driving the tunnel. Reigate Borough Council proposed, in the 1930s, to open the tunnel out to form a widened road cutting: fortunately this was not done, and the road tunnel is now pedestrianised and also the site from time to time of a street market and of displays of veteran cars.

The brick tunnel lining and the brick-built portals are Listed (Grade II).

There are also several ‘caves’ or rock-cut cellars at the rear of properties along the north side of Reigate High Street. These are noted in Knight, Frank & Rutley’s impressive sale catalogue of October 1921, when large parts of the town then belonging to a single owner were offered for sale in lots. Many are stated to have been blocked up by the military authorities during World War I.

The Barons’ Cave

The Barons’ Cave is excluded from this survey, as its primary purpose seems not to have been as a source of mined sand. It was first noted by William Camden in his *Britannia* in 1586, and may be an original feature of the castle. Whether or not it was intended as a sally-port is debatable, as some early descriptions appear to imply that there was at first no exit at the lower (western) end. Peter Burgess has suggested that the large side chamber was intended and used as a wine cellar. Later nineteenth-century descriptions and plans feature a roughly-cut side chamber some way down from the top entrance on the north side, to which the name ‘guard chamber’ has been applied. However, this feature is not shown on eighteenth-century plans, and is clearly a modern addition, perhaps representing crude small-scale sand-mining for local purposes.

Caves, mines, and underground quarries in Reigate

Although the cavities under Reigate town are locally referred to as ‘caves’ they are of course not natural caves at all, but man-made rock-cut excavations. Two natural,

or perhaps one should say semi-natural, caves have been recorded in the Folkestone Sand, near the railway, and also in sand pits north of Redhill. Both appear to have been formed in newly exposed rock faces in sand pits, where groundwater has been channelled by an impervious (possibly iron-cemented) layer, and washed sand out of the cliff face to form a cave.

These man-induced or semi-natural caves apart, Reigate (the original parish including the whole of Redhill) has had underground building-stone quarries (later possibly worked for refractory stone slabs), and certainly extended as hearthstone (mineral pigment) mines dug into the Upper Greensand along the foot of the North Downs escarpment; fullers’ earth mines in the Sandgate Beds close to the Nutfield boundary; and silver-sand mines in the Folkestone Sand in and around the town centre.

Folkestone Sand: lithology and mineralogy

The Folkestone Sand formation is a marine deposit of poorly or barely cemented quartz sand, with pebbly beds at top and bottom and a seam of silty or clay material near the top. It has been divided (Gossling) into four parts based on their lithology, in stratigraphical order as follows:

- [1] Upper pebbly sand 50 to 60 feet thick
- [2] Silt / clay band 10 feet thick
- [3] Silver sand 100 to 120 feet thick
- [4] Lower pebbly sand 10 to 20 feet thick

The pebbly beds appear to have found no economic use, but have been seen in recent years in a small rock-cut grotto (part of a former garden feature) on the north side of the railway line near Doods Way.

The exploited part of the silver-sand is all above the local water table, although the lowest parts of the London Road mines did at times contain standing water, indicating that the water table had been reached at that point.

A geological report (Fitton) made shortly after the road tunnel was driven noted the clay seam a little way above the tunnel ceiling. It has been described as ‘a dark greenish sandy clay; and as ‘a blue glauconitic silt’. This relatively impermeable bed presumably extends throughout much of the summit of the castle mound, and minimises water ingress into the mined cavities below. It has also been suggested that it prevents water loss into the ground from the wet moat, although the latter feature is certainly artificially puddled. However, the clay bed probably does direct much of the rainfall on the hill down dip into the moat.

Some nineteenth-century authors mention very colourful sand layers in the cutting, comparable to those of Alum Bay (Isle of Wight) or even Petra, the “rose red city, half as old as time”. Iron compounds, less than fully oxidised, accounted for green, blue and mauve sands. These were previously protected from oxidation by aerated percolating rainwater by the clay seam before that was removed in making the cutting. All the coloured sand now visible is one shade or another of yellow, orange or brown, all the

iron content now being fully oxidised by aerated percolating rainwater and of course exposure to the air. The bed mined is the hundred feet or more thickness of the silver-sand. Within this material natural cement, if present, is represented by minute wisps of clay linking grains, or of iron oxide. Overall both the porosity and permeability are very high, a large proportion of the rock being represented by air- or water-filled interlinked voids between the quartz grains. Any calcite mud, cement, or fossils that may once have been present have all been dissolved away by percolating water. Percolating water has also washed once-dissolved iron compounds out of large parts of the sand, concentrating them as more or less hydrated iron oxides in other parts of the rock or, occasionally, as seams of tough cemented sandstone known as ferricrete. This, when encountered, has been collected and can be seen used to form hard-wearing footpaths at one or two places around the castle mound: the material is called 'carstone' or 'brown flint'.

The silver-white iron-free areas of sand are 96 to 99 percent silica and contain the best materials for glass-making, for which a very low iron content is essential. Yellow, orange or brown sand would yield only glass suitable for making green or brown beer bottles and the like.

Folkestone Sand: engineering rock or engineering soil?

A barely cemented or uncemented rock consisting of little else than rounded grains seems no more likely to support itself than a heap of marbles! Curiously, however, the silver-sand hosts (in Tunnel Road West) unsupported mine galleries up to 13 feet wide and 16 feet high. Long-exposed to wind and rain, a cliff of this material has maintained a vertical face of 50 or 60 feet in the 'Electricity Works' pit north of the railway near Doods Way. Scanning electron microscope photographs of the sand reveal sand grains with vestigial wisps of clay or iron oxide holding them together, and alarmingly large empty interstitial voids.

The material lies on the border line between, in engineering terms, an 'engineering soil' and an 'engineering rock'. The former can be dug like uncohesive soils, but the latter can be cut out in rigid blocks like rock. Blocks of Reigate silver-sand can be extracted, with considerable care, as rigid cubes. But little effort is needed to crush them to loose sand. Once so crushed, it has proved impossible to compress the sand back into cohesive rock. This sort of material has been called a 'locked sand' and has been described from local samples by Richards and Barton (1999).

Hooper's (1945) assertion that the castle mound was augmented with upcast sand dug from the moat is implausible, as the disaggregated sand seems unlikely to have made a satisfactory foundation for the stone curtain wall and corner towers known (from a poorly executed drawing published in the eighteenth century) to have

stood around the inner bailey. The central part of the castle is almost certainly sculpted from in-situ rock.

Chronology: when did mining commence and end?

The available evidence suggests that although there were undoubtedly underground excavations in the sand before the middle of the eighteenth century, these supplied exclusively local needs. Industrial-scale mining probably developed after the improvement in the 1750s of the road up Reigate Hill, the opening of the Croydon & Reigate turnpike road in 1808, and perhaps the introduction of rail transport from Merstham in 1805, Redhill in 1841, and Reigate itself in 1849.

The major collapses of 1858 and 1860 appear to have reduced enthusiasm for mining in Reigate and, indeed, after 1860 sand extraction appears to have been largely from the several open pits around the then edges of the town, where extraction continued into the twentieth century (and still continues nearby at Buckland). The striking graffito HAA 1862 carved on a wall in Tunnel Road West may, or may not, indicate the last miner (possibly a member of the numerous Apted family, some of whom dealt in sand) and the last date of working this mine.

After the coming into force of the 1872 Metalliferous Mines Regulation Act, which act would have applied to sand mines despite its title, the southeastern mines in general are conspicuously absent from the reports of HM Inspectors of Mines before the 1890s. This is in part because the local mines were assigned firstly to the Manchester & Ireland, and later to the North Wales & Isle of Man, districts (Sowan, 1985)! Some fourteen years after the Act came into force the inspector, Joseph Dickinson, visited southeast England and noted that there were places in Surrey 'Where sand is worked' by mining .. the material being called 'silver or silver-white sand'. Specifically, he reported:

The sand has been mined at various places, and one side of the town of Reigate is said to be honeycombed. The present mine is close to the town of Godstone. The entrance is by drifts from the surface, the passages being driven narrow with the upper part in arched form, like cloisters. Besides the mining, there are open cast workings on various kinds of sand.

There was a brief revival of sand mining at the end of the century. A small sand mine is known (Le Neve Foster, 1897–1901) to have been entered from open pits on the west side of Park Lane during the years 1896–1900 (it was listed as a new mine in 1896). This appears to have been the site of the last silver-sand mining in Reigate, and was owned by Lady Henry Somerset and under the superintendence of her agent H. Sims. The workforce was a total of two men underground for each of the first three years; they were joined by two others at the surface in 1899; and in 1900 there were just two working outside the mine. Over the five years a total of 16,163 tons of sand was raised, valued at £1,234. Who bought it, and

what it was used for, is not known. In contrast, Surrey openworks 20 feet or more deep were responsible during 1900 for 43,065 tons of 'sand and gravel' valued at £2116.

Mining instability and its remediation

There have been two inadequately recorded major crown-hole collapses into mines in the town, in 1858 and 1860.

Palgrave (1860) reported of the Tunnel Road West mine that in 1858:

As the sand is hollowed out, pillars are left to bear up the soil above. The supports of a cave, that branches off from the Tunnel, were too much encroached upon, and during the summer of 1858, a subsidence took place, which caused the circular pit in the field next to the Castle Court. An opportune shower drove away a party of young cricketers from the spot, when the earth sank suddenly with such a rending sound as is given out by the tearing down of a large bough.



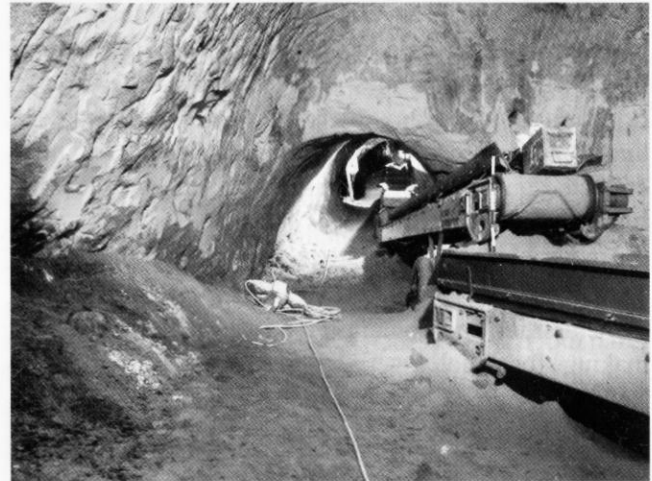
London Road mine: this point of access was formerly within a now-demolished building, the foundations of which could be seen hanging from the ceiling within the mine! Sand mines, more or less interconnected, are known to have been worked underneath the *Red Cross* public house (still in business) northwards under several shops and at least another two former public houses, the *Bats & Balls* and the *Three Pigeons*. It was a part of this complex that collapsed dramatically in 1860. Now-filled galleries extended eastwards under the Castle's dry moat and below the Barons' Cave.

Photo August 1987: Nick Catford

Below ground, it is possible to walk around three sides of this walled-off collapsed ground. In the Castle Grounds park above, the collapse forms an attractive sunken garden: few passers-by recognise it for what it is!

An illustrated article in the *Illustrated London News* of 19 May 1860 recorded the collapse of the back walls and back gardens of a row of London Road cottages that year. In or about the early 1980s a team from the Royal School of Mines (RSM) was engaged by Reigate & Banstead Borough Council to survey all accessible mines, or at least those for which the Council has responsibility. This may have been on account of a minor

run-in at one of the three shafts to Tunnel Road East mine, in or near the Town Hall car park at Castlefield Road. But more particularly there was anxiety about known and accessible mine cavities below Church Street and London Road, in view of ever-increasing traffic levels and authorised axle loads. That part of the London Road complex had for some decades, at least, been strengthened by massive brick-built pillars and arches, clearly visible within or from a subterranean wine bar which operated in this space with a stairway from a property on London Road.



London Road mine: this mine has been mostly backfilled (with sand of a different quality from another source).

Photo August 1987: Nick Catford

The present author has not gained access to the RSM report (Brown *et al*, 1985–86), but has seen the accompanying plans, which constitute the first and only accurate and overall survey known (although more or less satisfactory surveys have long existed of parts of some of the mines). As a result of the RSM findings, considerable areas of mined cavities were backfilled in or about 1987 (with sand!), as follows:

- [1] The whole of the Church Street mine.
- [2] Large parts of the London Road mine complex, especially below the road, standing property, and the Borough's public open space including the Barons' Cave.
- [3] Rear parts of the Market Caves, especially the Constitutional Club Cave and its connecting tunnel to Tunnel Road West.
- [4] Small areas adjoining the 1858 collapse into Tunnel Road West mine, which blocked access to the far end of the mine. To maintain access to that area, a new tunnel eight metres long was mined to the northwest of the collapse.
- [5] Several passages on the east side of Tunnel Road East mine, including the areas with which the three vertical shafts communicated.

In 1991 Arup Geotechnics, in the course of a nationwide review of mining instability (DoE Contract 7/1/271), selected the Reigate mines for one of the eleven Case Studies. The report appears to be based on the RSM



London Road mine: as can be seen here the mine tunnels were in places at a very shallow depth. There seem to have been entrances from former properties at numbers 2 to 16 London Road, and perhaps to an enigmatic address 'The Dug Out' further up the road which features in some later street directories. Occupiers include Donald Crear Scutt and Mrs. E.M. Scutt (between 1935 – 54), James Knight's removals and warehousing business, and an auction rooms. Various parts of the complex have been named after these occupiers and the former public houses.

Photo May 1987: Nick Catford

report, and includes scale plans of the Market / Constitutional Club and Reigate Lodge mines. It includes an estimate that 45,000 cubic metres of sand has been removed from voids below the town, which would represent several kilometres of mined tunnels, the exact figure depending on the average cross-sectional areas which range from around two to getting on for 20 square metres. The Arup text is derivative and in parts inaccurate inasmuch as the history of the mines is concerned. For example the stated last date of mining (1887) takes no account of the Reports of HM Inspectors of Mines for 1896–1900 which noted mining at Park Lane in five years at the end of the century. The list of dated subsidence events is also unreliable.

Other underground excavations or 'sand caves' at Reigate

This paper has been primarily concerned with 'industrial'-scale mining. This implies a specialised labour force working to some sort of plan, and producing material for general sale rather than for their own limited requirements.

Other mines in the Folkestone Sand in Surrey and Kent

The formation extends (as the name indicates) from the English Channel coast as far west as west Surrey and beyond, and has been mined at least on a small-scale at Hollingbourne and near Chipstead (Kent), and at Godstone, Dorking and Puttenham in Surrey. All these sites are, if anything, even less satisfactorily documented than the Reigate mines.

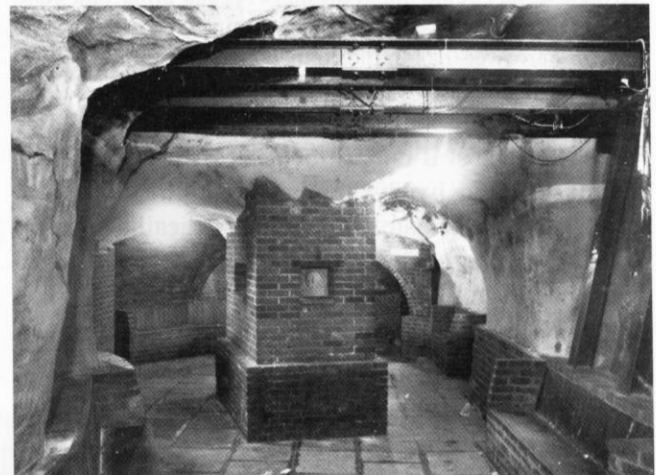
Other uses for sand

The emphasis in this paper has been primarily concerned with sand mined for glass-making in London. That would

relate to the highest quality, or whitest, sand from Reigate. However it is clear (especially from the sand visible in the walls of the Tunnel Road East mine) that much of the sand is iron-stained and suitable only for bottle-glass. It would have been pointless to offer this for sale in London, as equally poor sand could very readily have been obtained much more cheaply from riverside locations such as Charlton (where bottles were indeed manufactured) and Woolwich.

Much of the poorer quality sand would have been suitable (mixed with a binding agent) for use as casting or moulding sand in foundries, or of course as a constituent of mortar for building.

Applications likely have been relevant in and around eighteenth- and nineteenth-century Reigate include the use of sand as an abrasive or scouring agent (for cleaning cutlery and pots and pans), blotting ink-written documents (before blotting paper), brick and tile-making (including both fired clay and sand-lime bricks), friction sands (for locomotive sand-boxes), hour-glasses (including egg-timers), horticultural uses (lawn sand), sanding floors, and water filtration, amongst others.



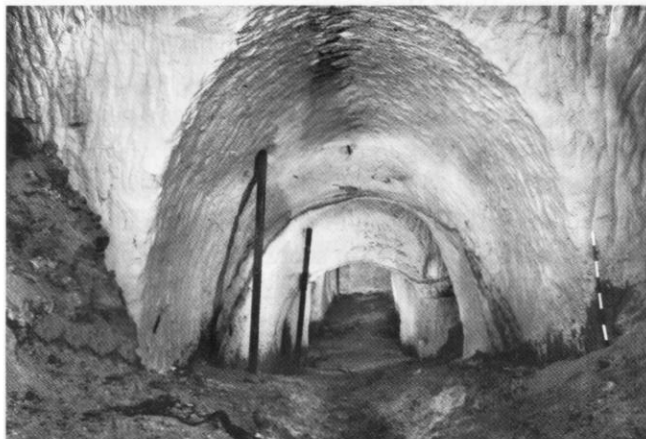
London Road mine: before large parts of this mine complex were backfilled there was an underground bar, partly below London Road, in what was locally called 'Scutt's cave'. Members of the Scutt family sold fruit and vegetables from the shop above. Photo April 1994: Nick Catford

Unresolved enigmas

Reigate's sand mines are astonishingly elusive in virtually all the surviving locally generated records which might be expected to refer to them. William Ridgeway's unpublished manuscript history of Reigate, despite including details of commercial interests in and around the town and parish (and an entertaining story concerning the Barons' Cave), says nothing about mines, although these were presumably a going concern in his day (the 1790s onwards).

The several industrial-scale workings, despite all being worked in one and the same deposit, vary widely in their physical forms. Some were worked exclusively by vertical shafts, while others were drift mines with horizontal entrances. Some such as Reigate Lodge South

have narrow galleries with a 'Gothic arch' profile; some, such as Tunnel Road East, have almost square section galleries about two metres wide and high, whereas Tunnel Road West has rounded arched ceiling profiles and gallery dimensions of four metres wide and five metres high. Some are rectilinear grids of pillar-and-stall working (those already mentioned) whereas others such as London Road have very irregular layouts on several levels.



Reigate Lodge South mine: the more regular pillar-and-stall mine galleries in this higher-level mine are lower and narrower than in the connected North mine.

Soil has run into the mine from a now-blocked shaft.

Photo June 1986: Nick Catford

Presumably most if not all the mines were worked by groups of men by agreement with the dominant landowners of Reigate Priory. The radically different styles of working suggest different gangs of men having different ideas of how best to extract the sand.

What proportion of the extracted sand was sent to London, at which glass-houses it was used, and what sort of glassware (tableware, bottles and jars, window-glass etc) was made from it are all unknown.

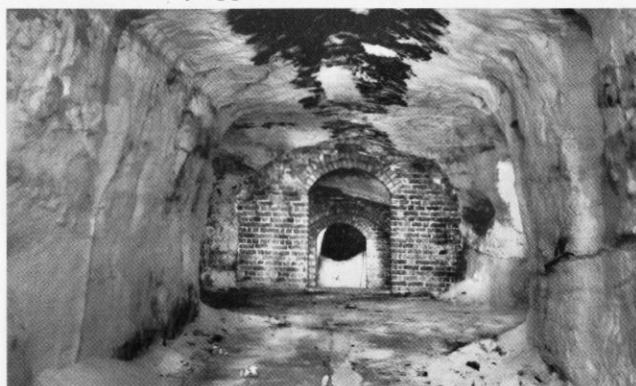
There may be further unrecorded voids under Reigate, although probably not industrial-scale sand-mines. John Aubrey [1626–97], writing some time between 1673 and his death in 1697, said of the Barons' Cave:

It [the Castle] is now much ruined: In the Area of it is an Entrance into a large Cave, or Vault, that runs under Ground several Perches, to a small Portal or Door that opens into the *Grasse* without the Castle. This Vault is bivial, and cut out of the Sand, several paces broad, and 5 Yards high, at the End which opens into the *Grasse*, or dry Ditch. This dry *Grasse* went, they say, from the Castle to the *Red Cross* Inn, and thence down to the *Priory* Cave. The Water Cave of this Castle goes under the Mote, which is full of Water; and the Tradition here is, that it reaches to *Bletchingley*; Not unlike this is another at *Winchester*, which reaches from the *Castle* to the *Cathedral* Church.

Aubrey's 'Priory cave' is not certainly known, but might be represented by a 'cave' recorded on the south side of the High Street. The Water Cave is mystery, but might be identified with the collapse in the Castle grounds reported in the early 1970s (Arup Geotechnics, 1991).

Some conclusions

When the South Eastern Railway opened through Redhill in or about 1842 (ultimately reaching Dover by this route in 1844) the company issued leaflets extolling features of note along the route, to encourage excursionists. The prime attraction noted at Reigate was the Barons' Cave! This proud tradition of subterranean tourism is currently maintained by members of the Wealden Cave & Mine Society (WCMS), who conduct the public, literally in their thousands, around the Barons' Cave and the Tunnel Road Caves on five Saturdays each year (and booked groups at other times by appointment).



Tunnel Road East mine: this part of the mine, in the north-west corner, has a square-cut flat-ceilinged profile, with no built brick support. It has, however, clearly had heavy timber supports at one time, as niches have been cut in the walls near the ceilings to accommodate couplings which appear to have been of approximately eight inches (20 cm) square uprights. Additional vertical timbers of much the same size appear also to have been placed along the centres of the galleries in this part of the mine, resting on the floor plates seen in the photograph. Such heavy timbering seems likely to have made these tunnels awkward to negotiate, and been inconvenient for wartime shelterers. There are no surviving traces of wartime timber seating or of bunks such as are often seen in other World War II shelters. Some of the lower parts of pillar corners (not seen in this view) have heavily scored brick protection indicative, possibly, of heavy loads being moved about on low trolleys, presumably in connection with pre-1940s storage, although whether crates of wine, barrels of beer, or military supplies is not known.

Photo December 1986: Nick Catford

English Heritage has (at last, one might say) now appreciated the value of industrial sites, and even of underground sites, as 'heritage assets'. The Reigate sand mines are the most accessible tangible relics of east Surrey's former position as one of London's most important suppliers of minerals.

Tourism apart, a number of members of WCMS have for some decades researched, recorded underground, and conserved access to most of the still-accessible mines and underground quarries, and indeed (in collaboration with landowners and occupiers) reopened a number of them.

For references and sources see

www.subbrit.org.uk/sb-sites/sites/r/reigate_sand/index.shtml

Steam on the Underground – a Personal Experience

Stewart Wild

On a cold evening recently around three hundred people, mostly men with a fair amount of grey hair, gathered on the District line platform at Kensington Olympia. A keen sense of anticipation was in the air. Forecast snow had yet to arrive but it was a train we were here for.

It was Sunday 13 January, the first weekend of London Underground's anniversary steam train experiences, and the special train was about to embark its first fare-paying passengers. Earlier in the day a couple of VIP trips had carried invited guests, politicians, senior staff and foreign dignitaries from Olympia to Moorgate, and now it was the punters' turn. I had been fortunate to get a last-minute ticket in the ballot organised by the London Transport Museum Friends, and my joining instructions told me to check in for carriage B, compartment 4.

I was given a rubberised wristband (Metro purple, with '150' logo) and an elegant 32-page commemorative booklet. Around 1900hrs those with cameras began to move towards the platform edge. At 1906hrs precisely the electric loco *Sarah Siddons* reversed into view, bringing the train into service from the depot at Lillie Road. Met Loco No. 1 brought up the rear, huffing and puffing and tooting to please the crowd.

Boarding took only a few minutes, and volunteer stewards attending each carriage rattled off a safety briefing. Nine of us settled into compartment 4, admiring the bench upholstery, the string net luggage racks, some original advertising panels, and the leather strap that allowed the window to remain partly open. Our tenth passenger boarded at the last minute, a London Underground supervisor/steward with blue Hi-Vis vest whose ready wit and prodigious knowledge of what was happening kept us informed and amused throughout the trip.

The train itself

Behind Met Loco No 1, as we set off towards Earls Court in the 100-yard-long parade of old Metropolitan rolling stock, was firstly a goods vehicle, Milk Van No 3, included as a support vehicle for the loco's footplate crew. The Milk Van was built in 1896 and used to bring milk daily from country farms into the heart of London. It was retired in 1936 and, as part of the Transport Museum's collection, has been carefully restored.



Met Loco No. 1 pulls in to Barbican station.

Photo Ed Webster

Behind this were five beautifully restored wooden-body slam-door carriages, including the Met Railway 1892 'Jubilee' carriage No. 353 which last carried passengers on the Underground in 1905. From 1905 to 1940 No. 353 worked on a light railway in Somerset, then after World War II was used a clubhouse for American servicemen, a low-cost home, an antiques shop and finally a farm outbuilding. It became part of the London Transport collection in 1974 and has undergone extensive restoration, most recently at the Ffestiniog Railway workshops where the compartments were brought back to first-class splendour.

The remaining four original carriages are known as the 'Chesham set'. They were built between 1898 and 1900 and worked on the outer reaches of the Metropolitan line until the arrival of electric stock in 1960, when they were sold to the Bluebell Railway. All four have been



Metropolitan Electric loco No. 12 *Sarah Siddons* leaving Lillie Bridge depot. Photo Jim Lock

restored and kept in use by the Bluebell; they returned there after their adventures in London.

Locomotive *Sarah Siddons*, built in 1923, brought up the rear, and was available to help in case of any problems with the engine at the other end. Electric loco No. 12, named after the famous Shakespearean actress who died in 1831, was built in Manchester in 1923, one of twenty 1,200-horsepower locomotives for the Metropolitan line that worked until electrification in 1961.

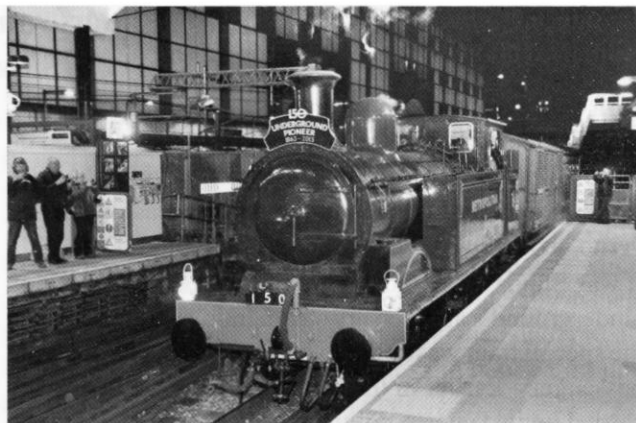
Smoke and steam in the tunnels

The guard blew his whistle and at 1915hrs, precisely on schedule, we were off. Clanking and jerking as the loco whistled and pulled away has never been more enjoyable! We were soon in a tunnel which magnified the sounds from the engine and smothered the train in smoke and steam, obscuring the view from the carriages and giving us a shower of smuts. Nobody minded of course, and one of our number pointed out that as the penalty for pulling the communication cord was clearly stated to be only £5, it would be well worth the money if we wanted to delay things!

At Earls Court hundreds of photographers packed every available viewpoint as we slowly passed through in a cloud of lovely steam and gritty smoke. Unfortunately for them, this was a non-stopping train, its speed carefully regulated to keep to a District line schedule and not encounter a red light. After the station, Met No. 1 huffed and puffed as it took up the gradient to High Street Kensington and round to Edgware Road.

At every station crowds thronged to applaud and take photos, while we could only imagine what onlookers would have thought back in 1863 when for many their first view of a belching mechanical monster would cause fear and alarm as the smoke smothered them.

Shortly after Baker Street we stopped in the tunnel, giving us a rare close-up view of the tunnel wall, its Victorian brickwork black and grimy but still apparently in sound condition. Passing through Kings Cross was somewhat surreal as we peered from our Victorian compartment



Met Loco No. 1 pulls in to Farringdon station.
Photo Robert Davidson

onto a brightly lit modern platform with its familiar bright red, white and blue roundels. At Farringdon, a pleasant mix of old and new architecture as the station prepares for Crossrail, those of us on the starboard side spotted the Underground's battery-powered loco waiting in a siding, ready for backup steam rescue if needed.

At 1947hrs, bang on schedule, we bumped and clanked and drew to a halt at Moorgate alongside carriages of a brand-new Met line train parked for comparison photos. More crowds pushed forward with excitement as camera flashes exploded, and it was all over.

There was time to browse the Museum's special trestle-table 'shop', piled high with splendid books, posters and other memorabilia, then we went our separate ways, mostly to stations where we could catch another view of Met No. 1 as it made its way back to Olympia within the hour.

The future

It's good to know that there will be further opportunities this year to ride behind Met No. 1, although not, alas, underground. There will be a service from Harrow to Amersham in May and September; on the Epping–Ongar railway in June; at Quainton Road in August; and a Santa Special in December. The London Transport Museum website has the details.

Metropolitan No. 1 E-Class 0-4-4T steam locomotive

The iconic and much photographed Met Loco No.1 dates from 1898, the last of three locomotives built at Neasden Works. On 4 July 1904, decorated with flags and bunting, it headed the first train on the opening of the Uxbridge branch of the Metropolitan Railway from Harrow-on-the-Hill.

In 1933 Met Loco No. 1 was taken into London Transport ownership, renumbered L.44 and repainted in LT livery. Thirty years later, on 23 May 1963, it took part in the Metropolitan Centenary parade before being withdrawn from public service. In 1965 it was sold to Quainton Railway Society as a working engine.

Between 1989 and 2000 the world's oldest underground steam locomotive returned to the Metropolitan line as part of 'Steam on the Met' heritage tours, although these did not run underground.

With help from Buckinghamshire Railway Society and London Transport Museum – and at a cost of around £250,000 – Met Loco No. 1 was restored in 2011–12 at the Flour Mill workshops in the Forest of Dean, Gloucestershire, to become part of a major ongoing heritage legacy to mark the Underground's 150th anniversary.

London Underground Birthday Trivia

Sundry snippets relating to the world's first underground passenger railway system on its 150th birthday

Stewart Wild

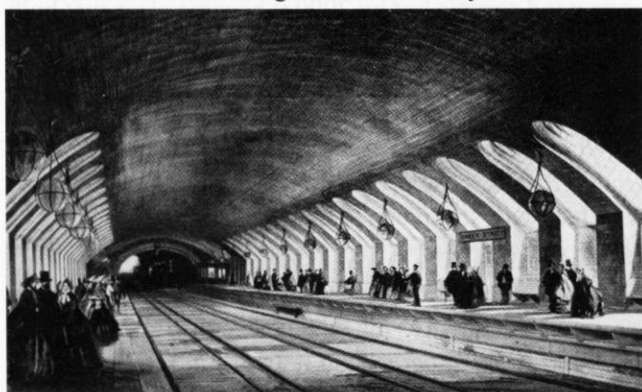
We all love our London Underground, celebrating this year the 150th anniversary of that first historic day – 10 January 1863 – when passengers rode behind a steam locomotive on the short four-mile underground journey between Paddington and Farringdon.

Over the years I have come across a wide range of sundry facts, factoids and useless information about the system, and as a sort of anniversary tribute from Sub Brit, I'd like to share some of them with readers of *Subterranea*.

In the beginning

The first line to open was the Metropolitan, between Paddington (Bishops Road) and Farringdon Street, connecting three London main-line terminals. It carried nearly 40,000 passengers on its first day, although how many came back for a second journey having been subjected to the noise and dust and smoke in the tunnels is not recorded.

The rolling stock was from the Great Western Railway (GWR) operating on seven-foot broad-gauge track (2.14 metres). The GWR ran some trains direct from Bristol and Reading via Paddington right through to Farringdon. Is this where Crossrail got the idea 150 years later?



Baker Street station in 1863

The first line was dual-gauge, designed to accommodate the standard gauge of the Metropolitan Railway, which had gas-lit wooden carriages drawn by a 2-4-0T tank engine with condensing apparatus, as well as the broad-gauge trains of the GWR. However, after only a few months of running their trains along the new line, the GWR withdrew and all the remaining Metropolitan trains ran on standard-gauge track.

Channel Tunnel?

The Metropolitan line was the idea of Sir Edward Watkin (1819–1901), railway entrepreneur and politician, who clearly had vision; his ultimate plan was to extend the Metropolitan line to the Kent coast and then under the Channel to France. He envisaged through trains from Manchester to Paris. What a preposterous idea! The government of the day squashed the plan on the grounds that it would make things too easy for a foreign invader, like frogs and asylum seekers.

Current Facts

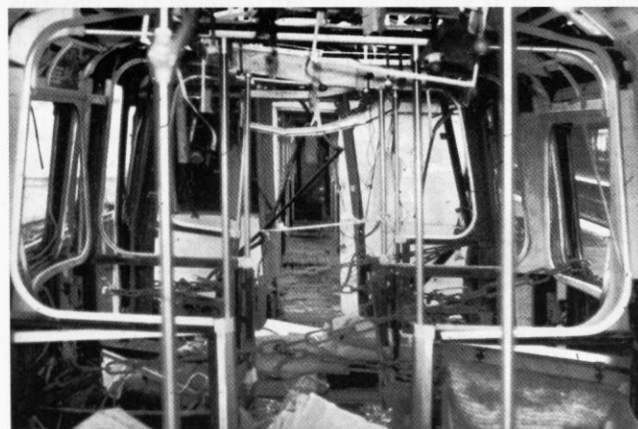
The total length of route served by London Underground trains at present is 255 miles (410km). Of this total, 56 percent is in the open, 37 percent in tunnels, and 7 percent in cut-and-cover. Each day over three million journeys are made on the network. Power is supplied by DC electricity at a nominal 630 volts through the third and fourth rails, although provision is being made for an upgrade to 750 volts in some areas.

What was the 'Tuppenny Tube'?

In the early days the Central line was known as the 'Tuppenny Tube' because the flat fare was two old pence. In July 1907 graduated fares of 2d and 3d were introduced: a 1d fare was added in 1909.

First terrorist attack

London's Tube has seen a number of terrorist attacks and serious incidents over 150 years, so there's sadly nothing new about politically-motivated explosions.



On 15 March 1976 an IRA bomb exploded on a Metropolitan Line train at West Ham station. Photo Nick Catford

The first atrocity was in October 1883 when a bunch of Irish Fenians seeking home rule set off some dynamite on the District line at Westminster Bridge station, and also at Paddington (Praed Street). Fortunately they were not very successful and there were no fatalities, although several dozen passengers were injured by shattered glass. There was a further explosion at Gower Street station (now Euston Square) on 2 January 1885; it was the last of an unsuccessful four-year Irish campaign of explosions in the capital.

The truth about the man with a wooden leg

The Underground's first moving staircase, one of a pair, was installed by Otis at Earl's Court station in 1911. Worried by a few minor accidents and torn dresses, passengers were at first loath to use this innovation and the story goes that the Underground employed a one-legged man to demonstrate how easy it was to get on and off this mechanical monster.

The fact is that this man, known as 'Bumper' Harris, was actually one of the installation engineers, and he was

asked to ride up and down on the first day, 4 October, because he had a wooden leg – this, it was felt, would inspire confidence in hesitant passengers. It is not known how Mr Harris suffered his loss, but it is on record that it was his left leg that was missing. There are now 426 escalators on the Underground, and Waterloo has the most at 23.

Top gear

London Underground's escalators usually run at a speed of 125 feet per minute (approx 1½ mph). At peak times, however, this speed can be increased to 145 feet per minute.

Another beginning

The first baby that is known to have been born on the Tube arrived at Elephant and Castle station in 1924, whether by Bakerloo or Northern line is not recorded. Her name was Marie Cordery. Later press reports that she was christened Thelma Ursula Beatrice Eleanor were soon found to be false.

Isle of Wight connections

What's the connection between the London Underground and the Isle of Wight? Sadly, not a tunnel. The obvious link is that ex-Northern line stock operates the island's railway between Ryde and Shanklin, but there's another connection, less well-known.



A class 486 EMU (formerly standard London Transport tube stock) waits at Sandown station before running on to Shanklin in July 1985. Photo Gordon Edgar

In Newport, the go-ahead company A.J Wells & Sons, established in 1972, makes expensive wood-burning stoves finished in vitreous enamel. However for the last twenty years, it has also been making a range of vitreous enamel signs for London Underground stations, ranging from large maps to station name-signs and smaller directional signs.

In an interview in August 2012, the sales director admitted that during a downturn in demand for stoves in the 1990s, their initiative in turning their expertise to making vitreous enamel information panels for LU and other railways saved the company from going under (ouch).

Even further south

The Isle of Wight is not the only island sporting former London Underground stock. A pair of ex-Northern line

1959-stock cars numbered 1044 and 1045 operates (behind a small diesel loco) on Alderney, the northernmost of our Channel Islands, during the summer months. The two-mile line, now run entirely by volunteers, was originally built in 1847 to haul stone from the quarry to the port and breakwater, and connects Mannez Quarry to Braye Road near the harbour. The first official passengers were Queen Victoria and Prince Albert, carried on 8 August 1854 in a horse-drawn tender.



A train bound for Mill Hill East awaits departure from Mannez Quarry on Alderney. Photo Dave Edwards

In 1987 two ex-London Underground 1938-stock cars were acquired from the North Downs Railway. These gave good service but by 2000 it became clear that both vehicles had unfortunately succumbed to corrosion caused by the salty sea air. They were returned to the mainland and scrapped. In 2001 the Alderney Railway acquired the two replacement 1959 tube cars from London Underground; these vehicles have aluminium bodies and with luck will survive the salt air.

Mind the dust

London Underground has a dustbuster unit that is very rarely seen. Known as the tunnel cleaning train, it is used throughout the underground network to remove tunnel dust that, if allowed to accumulate, could form both a fire and health hazard. Like most of LU's engineering units, it is painted bright yellow.

The leading car is adapted from 1938 tube stock, once the mainstay of the Bakerloo and Northern lines. Behind it are two special 'vacuum cars', which suck in and store the dust dislodged by powerful jets of air. How they eventually dispose of the dust isn't revealed.

Which is (or was) the Underground's least used station?

At the other end of the spectrum from Waterloo, which is the busiest station on the Underground network with an average of 224,500 passengers every day, the least used station seems to have been Blake Hall, on the Epping to Ongar branch of what was once the Central line.

By the time it closed on 31 October 1981, the station was reported to have served between six and seventeen passengers a day. The entire Epping to Ongar section was closed thirteen years later, on 30 September 1994.



The rural setting of Blake Hall station is apparent in this picture from April 1981. Photo Nick Catford

The station building at Blake Hall still exists (it has been converted into a private home), as does the newly reopened line passing it; but the passenger platform has gone and passengers passing on the restored Epping – Ongar steam heritage railway see only a long wooden fence with the old station behind.

These days the least used station appears to be Roding Valley, also on the Central line, which handles around 200,000 passengers a year, fewer than Waterloo and several other stations see in a single day.

Highest point above ground for the Underground

The Mill Hill East branch of the Northern line crosses one of north London's most dramatic features, the Dollis Brook Viaduct. This impressive brick structure, designed by Sir John Fowler and Walter Marr Brydone and built between 1863 and 1867, comprises thirteen arches each with a span of thirty feet, and is eighty feet high.

The single track here is the highest point above ground on the London Underground system. Sir John Fowler (1817–1898) was a pioneering railway engineer, the creator of the Metropolitan Railway and the designer of the famous Forth Bridge in 1883.

Yorkshire bridge turns up in London

Recycling is all the fashion nowadays, but it wasn't in the 1930s. Nevertheless there's a station and footbridge in north London, on the Northern line at West Finchley, that started life in Yorkshire and was relocated in 1932. The railway north from Finchley was built in 1872 by the Great Northern Railway which became part of the London and North Eastern Railway (LNER) in 1923. With stations at Woodside Park, Totteridge and High Barnet, it was operated by steam trains.

To serve the growing local population, a station was added at West Finchley in 1932 in the style of the other LNER stations, and station buildings and a footbridge were needed. It happened that they became available in Yorkshire.

Ryhill railway station was built for the Barnsley Coal Railway (later also part of the LNER) and opened in

September 1882. Renamed Ryhill and Winterset in March 1927, the station was closed by the LNER on 22 February 1930. Its buildings and footbridge over the tracks were dismantled, transported south and rebuilt at West Finchley where they still stand today.

West Finchley station welcomed its first passengers on 1 March 1933. Following electrification, the line to High Barnet became part of the Northern line in April 1940.

Victorian wall tiles and station names

Many Underground stations, especially on the Piccadilly and Northern lines, still have the original wall tiles with station names and directions, for example 'Way Out'. On the Northern line you can still see HEATH STREET, the original name for Hampstead, CAMDEN TOWN, KENTISH TOWN and MORNINGTON CRESCENT, while at Arsenal station (Piccadilly line) GILLESPIE ROAD is still proudly visible; the name changed on 31 December 1932. These long-lasting tiles were made in Shropshire, at the Jackfield Tile Works, where limited production still continues to this day.

The tile manufacturing process is now part of the Jackfield Tile Museum, one of ten former industrial sites that are part of the Ironbridge Gorge Museums Trust, with UNESCO World Heritage Site status. In the museum a small part of a tube station platform – the tiles show COVENT : GARDEN – has been recreated, complete with sound effects.

Tube train seen at street level!

For three days in 1996, office workers in Docklands must have thought they were hallucinating. The first car of a Tube train was mounted on the pavement at Canary Wharf where deep below, the station was under construction.

It was all part of publicity promoting the Jubilee Line Extension (JLE). A sample car from the new 1996 stock was on show from 29 to 31 May that year after being unveiled by Steven Norris, at that time Under Secretary of State for Transport and responsible for the JLE project. Canary Wharf station opened on 17 September 1999.

Another blast from the past

In 2010 work at Notting Hill Gate station on the Central line revealed a disused passageway that had been blocked since around 1960 when the station's lifts were removed and replaced by escalators. The walls of this old lift passageway are covered in advertising posters from the period 1958–1959, still in relatively good condition.

Amongst them are advertisements for Royal Blue coaches; Pepsodent toothpaste; the 1959 Ideal Home Exhibition; Michael Todd's 1956 blockbuster *Around the World in 80 Days*; and a new movie showing locally, *The Horse's Mouth*, starring Alec Guinness with paintings by John Bratby (it wasn't a success). Sadly the passageway is once again inaccessible, so don't ask the staff.

War effort underground

As part of the New Works Programme of 1935, London Transport ordered extensions to the Central line out of London to the east. At the outbreak of WWII the unfinished twin tunnels between Leytonstone and Newbury Park were fitted out as a bombproof aircraft components factory, at over five miles probably the longest, and certainly the narrowest, in the world.

Here in the cramped tunnels the Plessey company produced a vast array of components and equipment for the war effort, including shell cases, aircraft parts, and radio equipment for tanks, Spitfires and Lancaster and Halifax bombers.



The Plessey factory between Leytonstone and Newbury Park

The three intermediary underground stations – Wanstead, Redbridge and Gants Hill – although unfinished, served as secure air-raid shelters. An information board about the tunnels' first use is displayed with photos at platform level at Redbridge station.

Another underground tunnel pressed into service was at Earl's Court, where the passenger subway under Warwick Road which leads to the exhibition hall was also used for the assembly of aircraft components. The workforce was provided by London Transport employees volunteering to do their bit for the war effort after finishing their shift.

War effort in the air

Sharp-eyed plane spotters in World War II might have been puzzled to see London Transport's famous circle and bar motif on the fuselage of a Spitfire alongside an RAF roundel. LPTB staff raised £10,694 – enough money to pay for two of our most famous fighter aircraft. Of the two purchased only one, named *London Transport*, is positively identified. This was Spitfire Mk Vb, serial number EN597, whose name was painted either side of a logo. The aircraft was allocated on 20 June 1942 to the 31st Fighter Group,

United States Army Air Force (USAAF) and served in air support operations over occupied Europe and in North Africa, and later in Normandy after D-Day.

On 2 October 1944 the Spitfire experienced engine problems and crash-landed opposite Leuchars railway station; fortunately the pilot only suffered minor injuries. EN597 was declared Cat E damaged (written-off) and struck off charge – having been quite long-lived by the standards of some presentation aircraft.

The second aircraft presented by the staff of the London Passenger Transport Board remains unidentified; it was named *London Transport II* and was a standard Mk IX delivered in early 1944, so probably had an MK-prefixed serial number.

Digging for Victory

Flower gardens are a feature of many surface stations on the network, and staff are rightly proud of their efforts, with a certain amount of rivalry when competitions are mentioned. However, a new twist on digging activity came to light in July 2012 when the *Hampstead and Highgate Gazette* revealed that flowers, fruit trees and enough vegetables to feed staff at lunchtime are all growing in a small space behind the control room at the back of Hampstead station on the Northern line.

It all started in 2009 when station supervisor Neeta Patel transferred from Brent Cross station where she had done some gardening in her spare time. Now at Hampstead a fig tree is pushing up against a wire fence, potatoes are doing well and strawberries are growing next to the generator building. The garden is normally off-limits to the public but in August 2012 Mrs Patel arranged an open day. Visitors were shown round by a guide and the sale of flowers raised money for Cancer Research.

Way out of London

The Metropolitan Railway used to operate a service quite a distance west of Amersham, deep into Buckinghamshire, operating much more like a mainline railway. Amersham station at 492 feet above sea level is the highest point on the London Underground, and also the westernmost point at 27 miles from Baker Street.

Prior to the 1930s, the line was electrified as far as Rickmansworth with steam locomotives maintaining the service westwards from there. The line continued west of Amersham and served Aylesbury, Quainton Road, and then to remote Verney Junction, near Winslow in

Buckinghamshire. A branch was also maintained by the Metropolitan to Brill, a location not too far away from Oxford and plans were made to continue in that direction. However, in the 1930s it was decided to run the Metropolitan line more as an urban railway and its less busy westernmost extremities were no longer served. On 30 November 1935, the Brill branch closed. The service between Aylesbury and Verney Junction survived a little longer and closed on 11 July 1936.

Furthest point

When in 1891 the Metropolitan Railway arrived at Verney Junction, it was the furthest point from London ever reached by a London Underground line, fifty miles from Baker Street. The station premises are now a private residence while another railway building across the road, formerly a country inn with stables, is now the *Verney Arms*, a smart Italian restaurant.

Distances between stations

Londoners are well aware that some distances between stations (generally reckoned by LU as platform end to next platform end) in the capital's central area are so short that it's quicker to walk. The shortest is the 250 metres between Covent Garden and Leicester Square on the Piccadilly line; almost as short is the 270 metres between Embankment and Charing Cross on the Northern line. For comparison, Wapping to Rotherhithe through Brunel's famous tunnel is given as 510 metres. The 6.19km (3.87 miles) of single track between Chesham and Chalfont & Latimer on the Metropolitan line is the longest distance between stations on the whole network.

Tube stations named after pubs

As noted in the last edition, *Subterranea* 31, there are five stations on the London Underground that take their names from local pubs: *Angel*, *Elephant & Castle*, *Manor House*, *Royal Oak* and *Swiss Cottage*. I have now, however, found a sixth – see *Maida Vale* below.

Angel station (Northern line) opened on 17 November 1901 and took its name from the famous old coaching inn that once stood nearby, giving its name also to the area.

Elephant & Castle is named after an old tavern which was originally on the site of a sixteenth-century playhouse. As a sort of inn sign, the tavern had a model of an elephant and a castle on its frontage, which was preserved when the building was demolished in 1959. It is widely believed that the tavern's name came from a corruption of *Infanta de Castile* but this is an urban myth. The Northern line station opened on 18 December 1890.

Manor House, formerly *Manor Tavern*, once served travellers on the road to Cambridge, and was rebuilt in 1931. The adjacent station, on the Piccadilly line, opened the following year, on 19 September 1932.

Royal Oak was the name of an old country pub by the Westbourne river. It gave its name to the district and then the station, which was opened on the Metropolitan Railway

on 30 October 1871. The pub became the *Royal Tap* and is now known as *The Porchester*, on Bishop's Bridge Road. The area north of Regent's Park known as Swiss Cottage took its name from the *Swiss Tavern*, built in 1803 on the site of an old toll-house, later renamed *Swiss Cottage* on account of its appearance. The current pub of that name, designed to look like a genuine Swiss cottage, dates only from 1965. The original station below opened on 13 April 1868 but was relocated and rebuilt in 1939 when the Bakerloo line took over from the old Metropolitan Railway.

Maida Vale (Bakerloo line) takes its name from a pub on the Edgware Road named *The Hero of Maida*. In 1806 a British force under General Sir John Stuart defeated the French at the Battle of Maida, a small town in Calabria, in the 'toe' of Italy. Soon afterwards the first *Hero of Maida* pub opened, and gave its name to this part of Edgware Road as Maida Hill and later Maida Vale. The eponymous station opened on 6 June 1915, although the name *Elgin Avenue* had earlier been proposed.

Architectural gems

It is well known that several Underground stations have architectural merit, especially those designed by the distinguished modernist architect Charles Holden, but did you know that no fewer than eighteen station buildings enjoy official Grade II listed status?

These are: Aldwych, Belsize Park, Brent Cross, Caledonian Road, Chalk Farm, Chesham, Covent Garden, Hendon Central, Oxford Circus, Perivale, Redbridge, Russell Square, St John's Wood, West Acton and Wood Green.

In addition, in July 2011 three stations had their listing upgraded from Grade II to Grade II*: Arnos Grove, Oakwood and Sudbury Town. These were all designed by Charles Holden, who was also responsible for the Grade I listed railway headquarters building at 55 Broadway, London SW1, above St James' Park station.



The imposing station at Chalk Farm is one of the best examples of a station designed by another well respected architect Leslie Green

One-way Tickets

In 150 years only two coffins have ever knowingly been carried on the London Underground, that is, coffins carrying an occupant travelling without a ticket.

The first was in May 1898 when the body of four-times Prime Minister William Ewart Gladstone (1809–1898), who had died at his home in Hawarden, Flintshire on 19 May, was returned to London on his way to a state funeral and burial in Westminster Abbey. The route taken is not recorded, but it may have been Gower Street (present-day Euston Square) to Westminster Bridge using the Metropolitan/District Line.

The second was Dr Thomas Barnardo, founder of the famous children's homes. He died aged 60 on 19 September 1905 at St Leonard's Lodge, his home in Surbiton, Surrey. His coffin was transferred to the

Underground figures

Depth statistics

Maximum depth below mean sea level

Deep-level Tube lines

Maximum depth below ground level

Sub-surface cut and cover

Maximum depth below ground level

Central London

Deepest station below street level

Outer London

Deepest station below street level

People's Mission Church at the Edinburgh Castle, a former gin palace in Stepney, on 23 September where it remained for four days in order for his many supporters to pay their respects.

On 27 September an enormous procession of thousands, including 1,500 Barnardo boys, followed the hearse through London's East End, past many of the homes founded by the pious doctor, to Liverpool Street station. Here a special train was waiting to take the coffin to Barkingside station in Essex, which had opened a couple of years earlier.

Although the train was operated by the Great Eastern Railway, the track later became incorporated into the Central line and thus part of the Underground. Dr Barnardo was interred on 4 October 1905 in the grounds of the nearby Barnardo's Girls Village Home.

Jubilee line – 32 metres (105ft)

Northern line at Holly Bush Hill, Hampstead – 68.8 metres (221ft)

East London line at Wapping – 18.3 metres (60ft)

Bank (DLR platforms) – 41.4 metres (136ft)

Northern line at Hampstead – 58.5 metres (192ft)

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Thanks also to John Poole for help and advice.

Underground space: disused, currently in use, and in course of construction

Paul W Sowan

Subterranea Britannica concerns itself with man-made and man-used underground spaces, usually but not exclusively those to which access is possible.

Many of the places we research, visit, and write about are of course disused, whether Neolithic tombs or flint mines, or redundant Cold War bunkers. But not exclusively so. Working concerns are also on the menu. Recent examples where the management of Subterranea Britannica has successfully negotiated 'health & safety' issues include the storm water 'cavern' in St. Helier, Jersey; and the first and second rail tunnels (still used for access by Railtrack although not for rail traffic). Our view is that usually if there are conditions imposed for access, Subterranea Britannica can and will comply with them. Sites still in course of construction, at least in the UK, tend to be more problematic, but are not impossible.

Our best examples from recent years have more often been abroad, where interested visitors find themselves in the unfamiliar position of being regarded by site owners as intelligent and responsible adults, which tends not to be the case here at home! The new rail tunnel being driven under Stockholm, which we visited a year or two ago, is a good example. A job for Subterranea Britannica in coming years is to encourage civil engineers and their contractors (or their bosses) to allow access for suitably experienced and equipped persons to subterranean construction sites. After all, we frequently see news reports along with photographs as evidence that magazine and newspaper journalists are allowed access underground to such places. Arguably, many of our own members are at least as well-informed, intelligent, and responsible as them!



Exercise-Induced Asthma Countermanded by Cave Sport Therapy in Hungary

Sylvia P. Beamon

Generally speaking, exercise is believed to be a determining element in the physical and psychological development of children. Children who are skilful in physical activities and sports are more self-confident which helps them in problem-solving, and adapting themselves into their communities.

Most asthmatic children are kept away from sports and usually are unable to keep up with their peers in any case. Limitations in exercise and other physical activities increase the consciousness of illness in these youngsters who become more detached from their friends. They also feel less successful. This paradox requires a 'sport therapy' solution that provides asthmatic children with 'optimal load' (a Hungarian expression).

Speleotherapy has been used successfully for different respiratory diseases for decades in Hungary. Its beneficial effects are acknowledged here (although not in the UK or USA). The previous preferred practice was 'resting' treatment in caves. Patients spent several hours daily in the caves, and most included a programme of respiratory exercises. This therapy is useful as well, yet the potential of the natural environment is not used fully and efficiently.

Natural caves provide opportunities for exercise and sport, and even beginners can make exciting discoveries. With the help of experienced guides the physical aspect of a cave 'hike' is adjusted to the condition of the participants. The positive effects of climate and exercise reinforce each other. Crawling and climbing in the cave thoroughly exercise and strengthen all muscles. The success experienced in this way improves asthmatic children's state of health.

This type of therapy, as far as is known, has not been used by other countries in the treatment of asthma. Hungary seems to have stood alone in this respect.

i) The microclimate of caves

Nowadays our environment provides us with fewer places where damaging polluting agents, allergens, septic micro-organisms are kept away. Caves are therefore of the utmost importance, as the cleanness of the air and other advantages provide suitable places for therapeutic goals. The most important active components are as follows:

- the air temperature in the cave is constant, with an average of 10°C
- the relative degree of humidity is 80–100%, which is beneficial for asthmatic patients

- the calcium concentration in the air is very high (in karst/limestone)
- carbon dioxide content is approximately 0.1%, 10–15 times more than the score measured in the open air.
- lack of air-polluting gases (SO₂, NO₂, CO₂, ozone) and dust
- other allergens (e.g. pollen) cannot reach the air of caves
- septic micro-organisms are not viable in caves
- the negative-ion concentration is high, beneficial in respiratory diseases

Some caves in the Czech Republic, Hungary, Romania and Slovakia have been used for medical treatment for decades. Their therapeutic effect is unquestionable for asthmatics and those with bronchitis.

Ongoing research tries to determine the therapeutic value of caves in general. Some caves do not have therapeutic effects, while in others the improvement in patients' health is significant.



Patients at rest before starting treatment at a similar cave site to that in Hungary.

ii) Sport activities for asthmatic children

Physical training has a beneficial effect on the health of asthmatic children: their aerobic capacity and muscle strength increases, their endurance improves. Cardiac regulation and breathing techniques develop. Simultaneously their asthmatic symptoms recede, the number and intensity of attacks are moderated, and as a result their drug consumption can be reduced. Research shows that bronchospasms related to physical stress are less prevalent in asthmatic children practising sports.

This leads to the conclusion that the sports activity of asthmatic children should be supported as its beneficial effects accelerate the healing of asthma. Emerging

problems can be avoided by a well-chosen sport and its support by medical supervision.

It is fundamental that the asthmatic child chooses a sport where he/she is not exposed to the damaging effect of weather fronts and allergens. During the active work of the lungs these damaging effects can prevail. Therefore caves prove to be an ideal place for exercise, as they are allergen-free, micro-biologically clean, and where other factors (e.g. high relative humidity, CO₂ content, negative ion bias) are favourable as well. The high calcium content of the air in the cave must be highlighted for its effect in reducing inflammation and easing the chest.

This type of sports activity requires no training on behalf of the children themselves and it needs no special skill to practise it. Children will experience success already at their first opportunity, and apart from the beneficial effect of the physical training, the 'hike' improves the children's psychological condition as well.

Children prefer those sports where they experience success from the very beginning, and this sport is more exciting and interesting once they are acquainted with the mysterious world of caves.

iii) The practice of the Sport Therapy in Caves

The cave tour can be attended by medically supervised and managed children suffering from asthma, bronchitis and respiratory allergy. The tour guides are experienced people who have a good knowledge of each respective cave, can assess and adjust to the difficulties and the pace of the hike to the health status of these children.

Each tour is guided by two speleologists attending to 5–6 children. A nurse experienced in asthma treatment is also present. This hike is not a type of 'hygienic gymnastics'; children find it more like an adventure in nature, and enthusiastically carry out this effortless physical activity. Their feeling of safety is provided by the accompanying adults, who can assist their 'resting period/breathing space' whenever they are in need. Children soon realise that this need fades away as they quickly acquire the necessary skills for crawling and climbing and gaining in experience.

For effective therapy regular cave tours are required, at least for the period of 10–15 weeks, which should last for between a two to two-and-a-half-hour hike each time. Participants are split into groups, with between 4–7 persons in each group formed preferably of children of similar age and skill (all children must be aged six years or more). Registration is made by phone, and the hiking tours start each Saturday and Sunday at 10 am, and also at 1 pm.

The cave tours take place in the Ferenc-hegy cave. This cavern provides the opportunity for choosing from a

variety of tours with different levels of difficulty according to children's acquired skills. Each child receives a helmet equipped with a lamp and an overall to wear for the tour. Their parents and siblings can also attend. The pace of the hike is adjusted to the children's pace, offering as many breaks as needed. During the breaks children acquire geological knowledge, and photos are taken.

iv) The effects of the Sport Therapy in Caves

According to observations, 10–15 sessions are necessary for the therapy to show its effects. A thin discharge from the nose is noticed after the first encounter with the climate of the cave; a child would blow his/her nose more often, cough their secretion more easily.

At the beginning of a tour those asthmatic children with characteristically stridulous breathing (abnormal high-pitch sound caused by obstruction in the trachea or larynx), soon got rid of these uncomfortable symptoms. This therapy made it possible for many of them to reduce their drug dose, sometimes even to quit medication. No worsening of the children's health status during the cave hikes was noticed.

The peak-flow meter scores were continuously measured before and after touring. The PFM scores showed no worsening in the health status of the children. Preceding and following a 2–3 hour cave hike, the PFM scores are almost the same; however, the scores during the activity are often higher.

Studies show that children who previously had regularly attended cave tours, then took a long break, were in a worse shape than at the time of starting the break. Although their health was better compared to their condition before starting the tours, it was worse compared to their optimal condition. When the child engaged in cave hiking again, just one or two tours in the cave were enough to re-establish their optimal condition.

The substance of this article is the work of Zsuzsanna Sztanyi (*et al.*), pharmacist and project leader, Hungarian Society of Psychophysiology and Health Psychology Sport Therapy in Caves, Nagyvarad Ter 4. 1089 Budapest, Hungary.

Zsuzsanna gave me a copy of her translated report and verbally gave me permission to use it for which I give my grateful thanks. I wrote to various addresses in Hungary but was unable to locate individuals. It seems the programme was disbanded due to financial restraints c. 2008.

Editor's note: This paper was presented at the 11th International Symposium of Speleotherapy, Zlaté Hory, Czech Republic, in September, 1999. Sylvia Beamon is an academic historian, an expert in the study of ice-houses and the Royston Cave, and the founder of *Subterranea Britannica*.

Which two London Underground station names contain all five vowels?

Answer on page 64

Sidmouth Harbour Railway & Tunnel, Devon

John Perkin

The Sidmouth Harbour Railway was the first steam railway in Devon, although it was never used for its original purpose, lasted for only one year and predated the main line of the Bristol & Exeter Railway from the Somerset border to Exeter by seven to eight years.

Sidmouth is a small coastal town in east Devon which developed from a fishing village to an up-market seaside resort from the beginning of the nineteenth century. There is still no harbour but there have been many schemes, most recently the idea of a marina. One harbour scheme involved an industrial railway. In 1835 when the sea-wall was being constructed a harbour was suggested, and despite the lack of finance design plans were requested. Famous civil engineer William Cubitt was unable to produce a scheme within the anticipated resources and Henry Habberley Price agreed to act as Engineer. An Act was obtained in 1836 authorising a capital of £18,000 and work commenced early the following year.

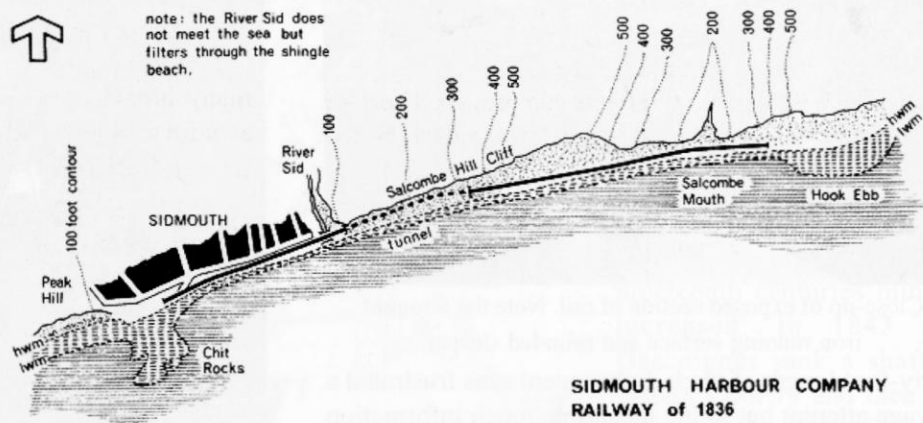
Piers are planned

On 24 May 1837 foundation stones for each of the two piers were laid. The western pier foundation stone was laid on behalf of the Russian Embassy as the pier was to be named after Grand Duchess Helena of Russia. The eastern pier was to be named after Princess Victoria. As it was also her birthday the whole town rejoiced with festivities continuing until late in the evening.

The two piers were to enclose ten acres at Chit Rocks to the west of the town and the stone for their construction was to come from deposits at Hook Ebb to the east of the River Sid. The foundation stones had been brought by lighter and some of the Company's shareholders stated that in the future that would be the preferred transport for the masonry.



note: the River Sid does not meet the sea but filters through the shingle beach.



SIDMOUTH HARBOUR COMPANY
RAILWAY of 1836

miles 1
1/2

Henry H. Price decided instead that a railway was required and expended a large sum in building the track. Work ceased during the winter of 1837 after storms did a large amount of damage. At a meeting in February 1838 it was decided to repair the railway and make further calls on the share capital which met with little response as £8,000 had been spent although construction of the harbour had not yet commenced.

Railway fails

Although the railway was nearly complete and the meeting expressed "great confidence", little more appears to have been done and the Company quietly faded away leaving two squared blocks on Chit Rocks and the remains of the railway. All of the shareholders thus lost their investment.

East of Sidmouth only a narrow shingle beach separates the cliff from the sea and after laying his line the length of the front Henry H. Price crossed the River Sid on a timber viaduct and tunnelled into Salcombe Cliff to protect the railway from the sea. After about a third of a mile the line emerged and continued along the foot of the cliff on piles to beyond Salcombe Mouth.

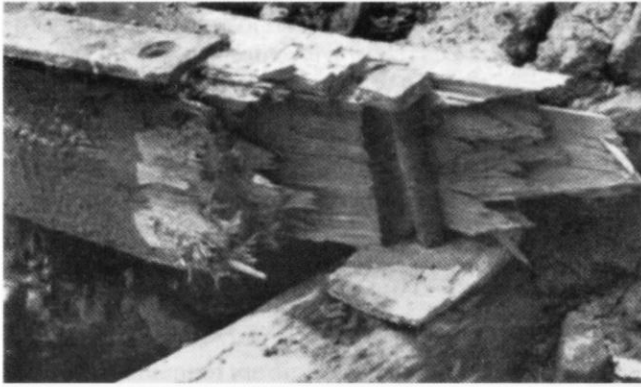
After work ceased most of the railway was removed but a cliff fall covered part of the line. The railway then lay hidden for some 130 years until storms revealed a



Section of railway exposed by cliff fall



Remains of piles used to support the railway on the beach section, looking west towards Sidmouth. The two lines of piles are 5ft apart: in each line piles are set at 4ft 6in intervals



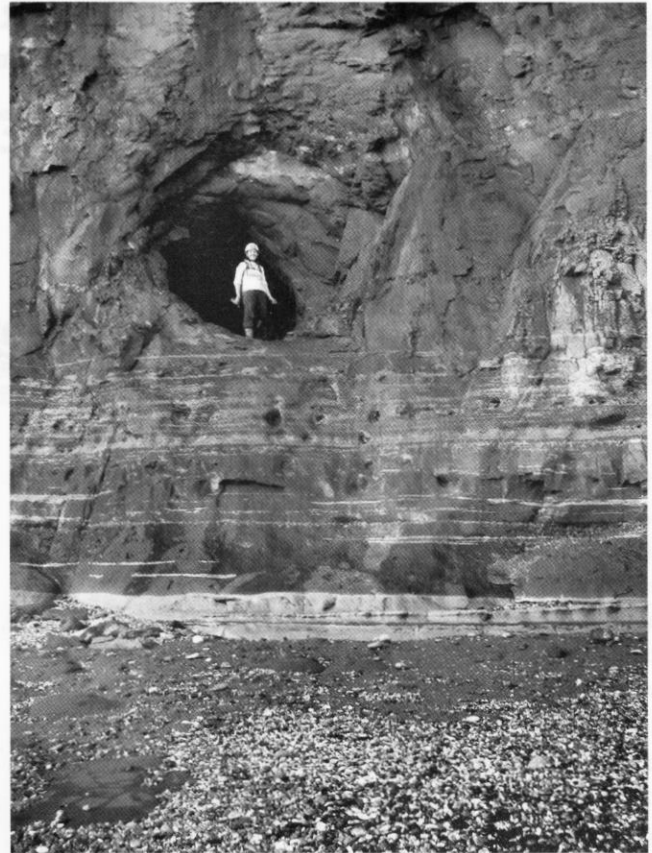
Close-up of exposed section of rail. Note the wrought iron running surface and rounded sleeper thirty-foot length of track. Subsequent seas frustrated a salvage attempt but in the meantime much information had been gained.

Tunnel finds other uses

A famous Devon smuggler gave up smuggling to carry stone for the Sidmouth Harbour Company, and perhaps he returned to his former profession. The tunnel was later blocked to thwart smugglers who found it a convenient store.

A local blacksmith by the name of Coles was commissioned to make a machine to run on the rails to transport the stone, but as it was only worked by manpower it was not satisfactory and a steam engine was ordered. The locomotive arrived by sea on Sidmouth beach. There was no crane powerful enough to unload the engine and so the ship sailed to Exmouth to unload instead. The engine was then drawn over the hills to Sidmouth. The locomotive proved too large for the tunnel but was used to give rides along the esplanade.

Henry H. Price was a partner in the Neath Abbey Ironworks building locomotives at this period and the locomotive, *Hawk*, came from this factory. Very few



The surviving west tunnel entrance in 2006.
Photo Will Kromhout, Devon Spelæological Society

records have survived and those that do show no reference to the Sidmouth Harbour Company or railway. Due to the rapid coastal erosion of the east cliff all evidence of its existence will probably disappear very soon. The west tunnel mouth can still be seen in the cliff 15 feet above the level of the beach. The tunnel contains deep water in sections and is home to lesser horseshoe bats. About 200 metres remain, and when the cliff line

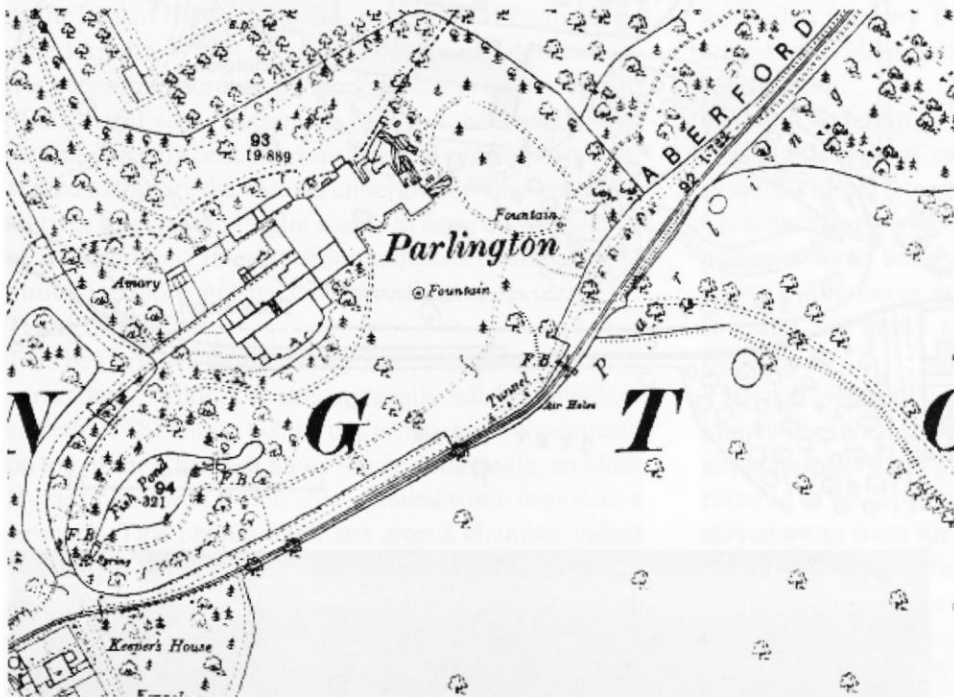


Inside the railway tunnel. Photo Peter Glanvill

erodes back to the tunnel, which runs parallel to the cliff, there will in time be a very spectacular cliff fall! Although the rock is relatively unstable red marl it contains enough calcium carbonate for stalagmite formations to have developed making the walls quite colourful in places. Plan and old photographs by M J Messenger reproduced with permission from the Industrial Railway Society.

The Dark Arch and the Aberford Railway, Yorkshire

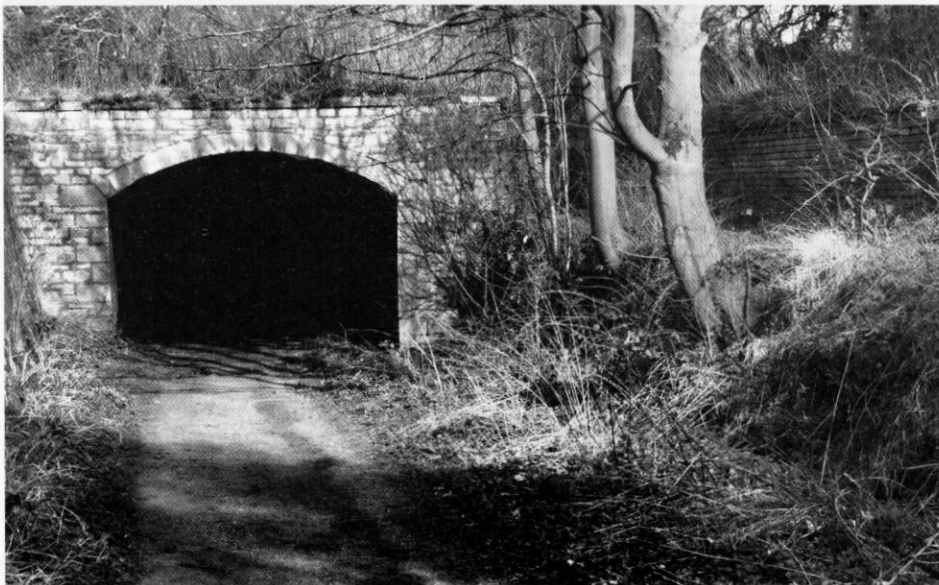
Phil Marshall



1898 1:2,500 OS Map

The Dark Arch is the peculiarly named subway which carries Parlington Lane under the lawn of Parlington Hall near Aberford, in the West Riding of Yorkshire. Constructed in 1813, it enabled the Gascoigne family to have a clear view over the deer park, uninterrupted by the coal wagons using Parlington Lane. Where it passed Parlington Hall, the lane was lowered by a few feet and arched over.

The subway is 85 yards in length and partially below ground, with a sunk fence on the south side to keep livestock off the lawn without obstructing the view. It is constructed of masonry with vertical sidewalls and the arch is a segment of a circle. Illumination is provided by vents in the roof.



West portal. The railway trackbed is to the right, at a higher level than Parlington Lane.

Centuries of coal mining

The Gascoigne estate included the Garforth collieries. Coal is known to have been mined here since 1262 and possibly back to Roman times where the coal seams were shallow enough. During the eighteenth and nineteenth centuries mining increased: in 1843 the Gascoignes sank a shaft at Sisters Colliery and then ten years later Isabella Colliery was opened.

Garforth is on the northeastern corner of the Yorkshire coalfield, so there was a limited market to the south or east because cities such as Leeds would have collieries much closer to them and Garforth

could not compete due to the extra cost of haulage. Therefore the obvious solution was to send the coal north, to towns such as Tadcaster.

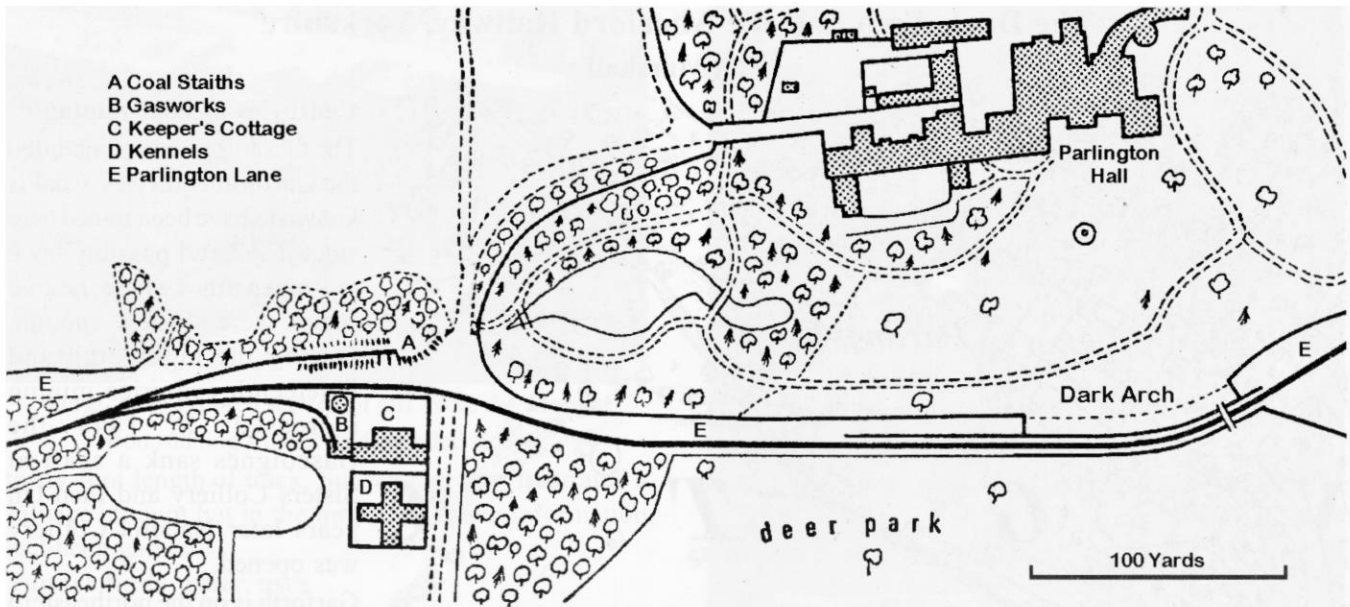
To facilitate this trade, in the 1830s the Gascoignes built a three-mile horse-drawn tramway from Garforth to the Great North Road at Aberford. The line was constructed on a falling gradient from the collieries. Once the wagons were on the move, the horse would jump nimbly aboard its own 'dandy cart' at the rear of the train and enjoy the ride down to Aberford before pulling the empties back up to Garforth.

There was also a passenger service, and it is reported that, in poor weather when the horse was unable to get a good footing, it was not unknown for the coach to arrive

at Isabella with all the passengers pushing behind! Steam traction was introduced in 1870.

The railway line ran alongside Parlington Lane for part of its route, and although the Dark Arch has the appearance of a railway tunnel, it was not utilised by the Aberford Railway. Because the lane had been lowered in order not to obstruct the view of the deer park, the gradients were deemed unsuitable and instead of going through the Dark Arch it went along the ditch made for the sunk fence. Since the trains would therefore be visible from



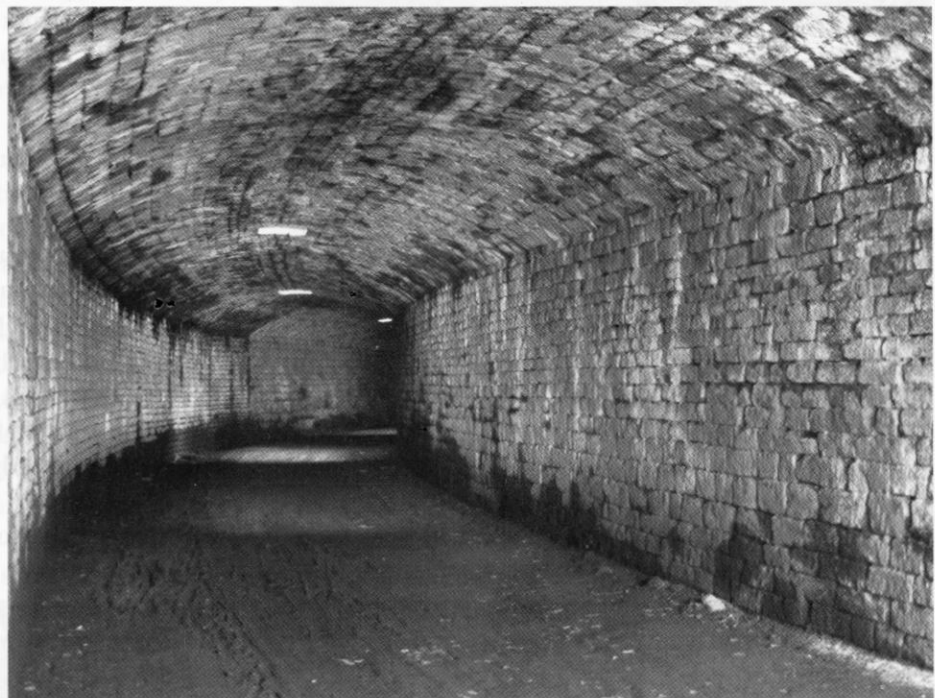


Parlington Hall, one would have thought that it would defeat the object of building the Dark Arch in the first place.

Eventual closure

The Garforth collieries were eventually worked out and became uneconomic. Sisters Colliery closed in 1922 and Isabella shortly after. The Aberford Railway, having served its purpose, closed in 1924.

The Aberford Railway trackbed is now a public footpath and bridleway and it is an easy walk from Aberford to the Dark Arch.



Internal view of the Dark Arch. Note the lighting apertures in the roof



The Dark Arch and the lawn of Parlington Hall. The Hall is just visible to the left

Further reading:

The Aberford Railway and the history of the Garforth Collieries by Graham Hudson. David & Charles, 1971.

Parlington Hall: <http://www.parlington.co.uk/>

Photos by Phil Marshall

Answer to London Underground Quiz

The two underground station names containing all five vowels are

Mansion House and South Ealing

[Heathrow Terminal 4 would also qualify if the 4 were written as Four, which it never is....]

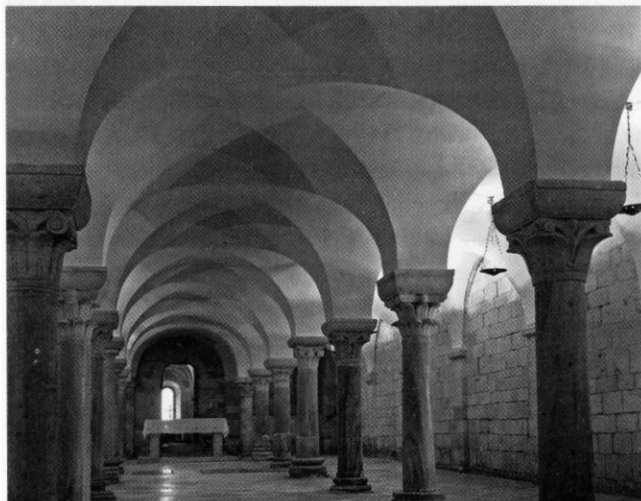
Caves, Grottoes, Tombs and Tunnels in Puglia, Italy

John and Jennie Lill

At the heel of Italy's 'boot' lies the region of Puglia, also called Apulia. Whilst not a traditional tourist destination, it is becoming increasingly popular due to an abundance of historical sites, Baroque towns and the usual Italian charms of sandy beaches, sunshine and excellent cuisine. Added to this are the various underground sites scattered all over this region. Puglia seems to have an abundance of underground interest from standard church crypts through to more unusual cave dwellings.

Trani Cathedral

This beautiful twelfth-century Romanesque building is particularly striking, as it is unusually tall for a Puglian cathedral. The reason behind this is that it was constructed on top of the Chiesa di Santa Maria della Scala, an older Byzantine church which still contains some impressive frescoes. This church itself sits atop a chamber called the Ipogeo San Leucio that is believed to date from the sixth or seventh century AD. The cathedral also has its own crypt, which lies alongside the Byzantine church.



Trani Lower Church. Photo Bob Miller

Ostuni

Sitting atop a hill, the whitewashed town of Ostuni is littered with cellars and crypts. Most of the properties in the town have a cellar and as you wander through the streets to the top of the hill you have the chance to peer into them as many have been converted into an additional part of the various commercial premises. Some are used simply as cold stores for the houses dotted amongst the shops and restaurants.

In the surrounding countryside of Ostuni is a hotel containing the remnants of a once common feature in this region, underground olive presses. In this area of the Salento – the peninsular region within Puglia – fortified farms were traditionally built over or near caves that were then adapted to the individual needs of the farm. Many families used these caves as accommodation for either workers or animals and some were used to house underground olive presses. In more turbulent times they

were also used by the farmers and other locals as a refuge, providing protection from whatever threat was approaching.

Grotte Castellana

Whilst this area of southern Italy is riddled with cave systems, most are closed to the public. At Grotte Castellana, however, over 3km of tunnels, chambers and passages have been explored so far and are open to visitors. The caves are limestone with calcite deposits forming the many stalactites and stalagmites seen throughout.

The large deep pothole near the town of Castellana was known about for many years. Local people told stories about monsters and ghosts living inside the chasm they referred to as *La Grave* (the deep). Not all of the locals stayed away from the caves as it was used as a rubbish dump until the twentieth century.

It was through the pothole of *La Grave* that the famous naturalist and geologist Franco Anelli (1899–1977) descended in 1938. Whilst Professor Anelli was the first person to explore and map these caves, there is documented evidence that the caves had been visited since the mid-eighteenth century.

La Grave itself is 70m deep which is approximately the level of the whole system. It would seem to be a huge hall but is actually a passage, 50m wide, nearly 60m high in places and stretching for nearly 600m. The passage is separated into chambers by huge formations creating towers, bridges and walls.

Following on from this passage is a smaller one leading to the southeast branch of the complex. The first 700m of the system shows similar formations to those in *La Grave* but at the end is the *Grotta Bianca* (the White Cave). This cave, discovered in 1939 by Vito Materrese, is an incredible sight where due to the nature of the water and undisturbed environment, crystals have covered the common formations to make them look almost white.

Sea caves

Whilst the main area of Puglia contains networks of tunnels and caves, the coastal region also has its fair share. Along the coast from Viesta in the north to Castro in the south lie sea caves. Unfortunately they are very difficult to reach as most are only accessible by boat.

These caves have been inhabited since Neolithic times and most are covered in wall paintings. Many of the paintings are suffering the effects of salt-water damage and because of this the majority of the caves are closed to the public. Polignano a Mare in the province of Bari is one of the more renowned areas for sea caves. The huge underground caves and grotto contain clear blue water (which gives the town its name) and the caves are so deep they extend right to the centre of town.

There are also numerous other caves along this coastline like the Violet Cave and the *Campana Piccola*. The *Campana Grande* can bestow an exciting play of lights when the conditions are right. Further south there is the *Grotta dei Cervi* in Porto Badisco which contains Neolithic hunting scenes and magic symbols. There is also the *Romanelli* cave with its prehistoric graffiti, paintings and engravings that date back some eleven thousand years and the *Zinzulusa* in Castro that is filled with stalactites.

Gnathia and Egnazia

In any other country the ruins of the Greco-Messapian city of Gnathia would be viewed as being of incredibly high importance. Unfortunately sites like this are found in abundance in Italy but that doesn't detract from their historical interest. The earliest human presence in Gnathia dates back to the thirteenth to twelfth centuries BC but it remained a small settlement until the fifth century BC when the main city walls were built.



Egnazia tombs

Although some pre-Roman tombs have been found within the city walls, the main Messapian necropolis of Egnazia is situated outside the city. Pottery from the fourth–third century BC has been found in these tombs although prior to this the area was a quarry. Whilst most of the tombs are pseudo-sarcophagi they are mixed in with chamber and semi-chamber tombs.

These chambers were created first by digging a large hole in the ground. Then the walls of the hole were strengthened by pieces of rock which were also decorated with various scenes from local life. Finally a huge slab was placed over the top as a roof essentially creating an oversized underground coffin.

These tombs were latterly used between the tenth and twelfth centuries AD as refuge from conflicts and occasionally converted into habitations.

There is also an area called the Criptoporticus under the old city (not open to the public) that was partly carved from the bedrock and partly constructed from concrete with a plastered facing. The small complex has four arms of different length and it is variously explained as a covered walkway or a place for storing grain.



Inside one of the Egnazia tombs

The onsite museum is excellent (although much is in Italian only) and houses a large collection of artefacts from the site. There are also a number of other items from here (including mosaics) that are on display in the Archaeological Museum in Naples.

Matera

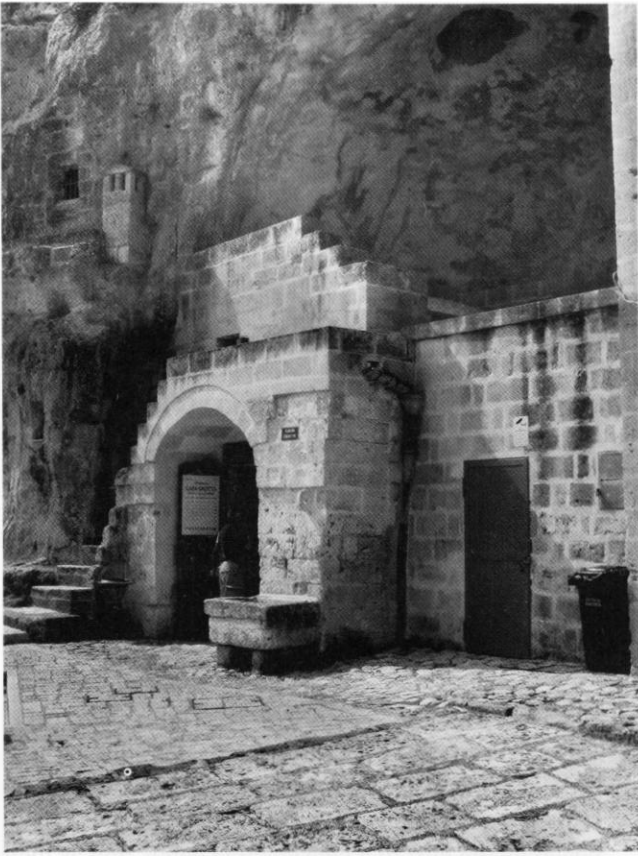
There are several cave cities in Puglia including Ginosa, Massafra and Mottola. Matera, however, the most impressive, is 20km across the border in Basilicata on the instep of Italy's boot. The area has been settled since the Palaeolithic period with the town allegedly being founded by the Romans in the third century BC.

In the seventh and eighth centuries AD some of the natural grottoes were colonized by both Benedictine and Greek Orthodox monastic institutions. Whether this was the start of the main human occupation of the caves is not clear. The people of this area carved dwellings directly into the surrounding ravines and gullies made of tufa, a honey-coloured soft stone. Through an ingenious system of canals, fresh water and sewage were controlled and shafts also ensured there was some natural light to the caves. The area prospered and was the capital of Basilicata from 1663 until 1806.



Matera 'Sassi' Rock Caves

The cave dwellings or *Sassi*, meaning 'stones', were successful dwellings until mass migration of people to the area during the eighteenth and twentieth centuries caused overcrowding. People began using caves that had been previously designated for livestock with the result that by



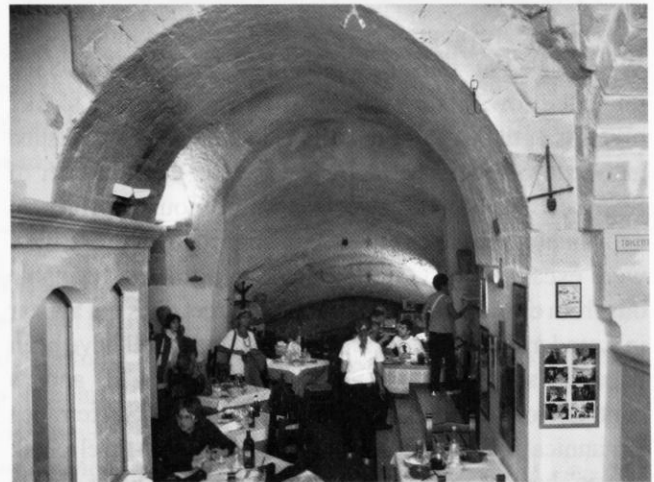
One of the inhabited rock dwellings

the 1950s more than half of Matera's population lived in a *sassi* and child mortality was at fifty percent.

With foreign correspondents highlighting the situation to the world, the Italian government was finally galvanised into action. By the late 1950s they had relocated about fifteen thousand inhabitants en masse to a new town on the plateau above the ravine.

There are still more than three thousand habitable caves in the area and over 150 rock churches in the ravines, many of them Byzantine. One of the most important monuments in Matera is the complex of Chiesa Madonna delle Virtu containing dozens of caves spread over two floors.

It is comprised of two monastic complexes: the church of the Madonna delle Virtu was built around the tenth century whilst above it sits the simple church of San Nicola dei Greci. Caves and tunnels link many of the churches with some only being accessible through other buildings. The Chiesa di San Francesco d'Assisi has a seventeenth-century Baroque facade but was originally built in the thirteenth century above two rock-cut churches. These rock churches can now only be accessed through one of the chapels inside the church. Matera was designated a UNESCO World Heritage Site in 1993. Many of the cave dwellings and rock churches are now open to the public while other caves have been converted into bars, restaurants and other commercial enterprises.



Matera Rock Restaurant showing deeper cave system
All photos by John and Jennie Lill unless stated

I read it in a book .. it must be true! Nonsense at Beddington, London Borough of Sutton

A description of Beddington, now a part of the London Borough of Sutton, in J. Pigot's *Royal National and Commercial Directory and Topography*, dated November 1839, states that 'In this parish is a cave, wherein, it is said, the barons held a conference the evening previous to their meeting King John at Runnymede, when they compelled him to sign *Magna Charta*; the place is now used as a cellar by an innkeeper whose house is contiguous to it'.

This is complete nonsense, the so-called Barons' Cave being indisputably below the castle at Reigate, first

recorded by William Camden in his book *Britannia* in 1586.

The Plough Inn at Beddington, opposite the now sealed entrance to the 'Beddington caves' (which do certainly exist) is listed under Taverns and Public Houses in the same directory, Ann Rowe being the licensee in 1839.

Camden, however, said nothing about the rebellious barons meeting at Reigate. That story first appeared in print in the first edition in the early 1690s of *The new state of England* by Guy Miège, and is probably an early example of invented history by a cave guide.

World War I air-raid shelters in Dover, Kent

Paul W. Sowan

During World War I Dover, on account of the strategic importance of its harbour and of its nearness to France, was bombed both from German zeppelins and from fixed-wing aircraft. A history of the town during the 'Great War' that was to have ended all wars, but didn't, was published by Alfred Leney & Co. Ltd, a local firm of brewers. This informs us that the first bomb fell in the morning of 24 December 1914 (hardly a good omen for a happy Christmas!), with many more to follow. It also contains brief details and two illustrations of what are referred to as 'air-raid refuges', one of which (illustrated) was in the vaults under the Phoenix brewery buildings.



'Caves' in Trevannion Street, the (? road) tunnel in the Western Heights fortifications, and the 'crypt' (police cells) under the Town Hall were also used. The site of the former oil mills at the foot of the cliffs is in what was later called Limekiln Street (in effect a westwards continuation of Snargate Street): the street name obviously offers an explanation for the original purpose for which the 'caves' were excavated. The mills probably extracted vegetable oils from crushed seeds. Trevannion Street does not appear in a modern street atlas for Dover, but may well have been what has subsequently been re-named East Cliff and its continuation Athol Terrace. Older members of *Subterranea Britannica* will remember visiting the street-level chalk 'caves' here at the foot of the cliffs under Dover Castle during a Study Weekend some years ago.

The Oil Mill 'Caves', entirely man-made, are amongst Dover's less well-known subterranean sites, and are extensive, intricately varied on several levels, enigmatic, and fascinating. At the town end they communicate, via a doorway and a few steps down, with the Harbour Tunnel, where electric trains can be watched passing to and fro! There are numerous (now blocked or locked) entrances at street level, at the rear of what is now a petrol filling station, and a few more dotted about at higher levels in the cliff. The street-level caves form a small network of high, wide chalk tunnels. From these a smaller series of even higher and wider tunnels, of what might be described almost as cathedral-like proportions, leads the visitor through to the way into the railway tunnel. Curious steeply sloping low tunnels allow access to higher levels in the cliff, where larger excavations accommodate what appear to be open-topped

concrete-lined tanks, and one or two openings in the cliff face allow views out over the Western Docks. Little seems to be known about the history of these higher levels, although World War II water-tanks seem a plausible explanation, with the small steep access tunnels provided primarily as routes for pipes. Progress around the whole system is hindered by numerous inserted brick partition walls, which have to be climbed over, although at one point on the street-level it is possible to crawl through a hole made by persons unknown. The photograph in Firth's book (facing page 86) shows a large group of adults and children in one of the high-ceilinged street-level tunnels, along with a bench, what looks like a home-made bed, and some sort of small barrow or hand-cart. There is a single naked electric light bulb suspended between two of the tunnel walls. Judging by the standing adults shown, the ceiling (out of the shot) is at least 20 to 25 feet above floor level. The relevant text, in pages 91 – 92, tells us that ...

The largest and most secure of these [air raid refuges] was ready made to hand. At the back of the old Oil Mills, in Snargate Street, are large caverns excavated out of the solid chalk under the Western Heights. These penetrate the cliff to a considerable depth, and as their broad and lofty chambers lead out of one another and are well provided with exits and entrances, they are as well ventilated as caverns can possibly be. Wooden benches were fixed along the walls; separate caves were set apart for men and women; and order was kept both by voluntary helpers and by detachments of soldiers from the adjoining factory, which had been turned into a rest barrack.

The group shown in the photograph is of adults of both sexes, but predominantly children.

On some nights thousands of soldiers and civilians took shelter in these caves, waiting until the "All clear" signal was sounded, and a considerable number of the more nervous people from the poorer houses in the neighbourhood regularly used these caves as their night quarters. Every evening, as soon as the gates were opened, they appeared with their children, bringing bedding and chairs wherewith to make themselves comfortable for the night. Once inside they knew themselves perfectly safe, with hundreds of feet of chalk above them as a solid protection against bomb or shell.

As the old oil-mill buildings are stated to have been in use as barracks, it can be assumed that the higher-level tank caverns and steeply inclined pipe tunnels were not functionally associated with the factory unless they pre-dated World War I. It seems more likely that these higher-level additions to the system were made in World War II, and were perhaps some sort of freshwater storage system for supplying ships or adjoining premises, or perhaps laid on for fire-fighting purposes.

SOURCE: FIRTH, J.B., c. 1920, *Dover and the Great War*. Dover: Alfred Leney & Co. Ltd: 131pp + plates.

Discounted Cotswold Shopping

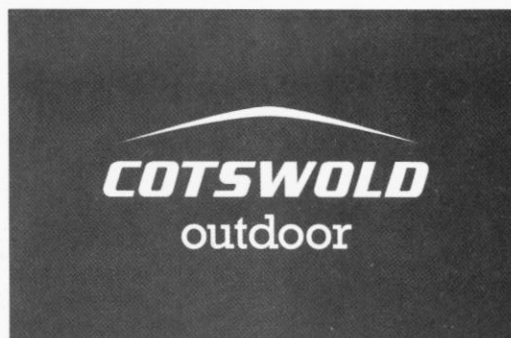
Cotswold Outdoor have granted Sub Brit members a 15% discount on their products (excluding sales and special offers). The details are included in a letter on the website at

www.subbrit.org.uk/docs/discount-cotswold-outdoor.pdf

If you are not able to access the website, then please contact us with an SAE for a copy of the letter.

The discount code can be used in any of their 58 stores (there is a barcode on the letter), and for telephone and online orders.

**** Please do not share or abuse the code as this may lead Cotswold to withdraw it which would be a great shame and spoil things for the rest of our members. ****



Here is an introduction from David Hague of Cotswold:

“Cotswold Outdoor are proud to be a supporter of such a prestigious organisation as Sub Brit. As most of your members are aware, Cotswold Outdoor is a multi-award winning retailer with numerous thriving stores located nationwide. Not only are we proud of our knowledgeable staff, but our stores stock one of the most comprehensive ranges of outdoor clothing and equipment in the UK. With a huge range of footwear, waterproof jackets and fleeces, tents, sleeping bags and outdoor accessories, we offer one of the best selections of clothing and equipment right on your doorstep.

Whoever you are and whatever you need, when you shop with us you can be assured of expert, award-winning service and advice that comes from 40 years of experience in retailing. We’re really looking forward to welcoming you to our store, online or over the phone soon. I hope that our discount helps your members purchase the right kit and equipment as they continue with their important and valued pastime. We are passionate about giving the right advice and recommending the right clothing and equipment so you can have peace of mind while out in (or should that be under!) the field.”

Subterranea 33 will be published late August 2013

and the following features will be included

Sub Brit visit to Alderney

Kenley and Coulsdon deep-level air-raid shelters

Wilton Park AFHQ revisited

Sub Brit 2012 Liverpool Autumn Meeting and visits



Sub Brit members suited and booted awaiting access to the Edge Hill cutting and Wapping and Crown Hill tunnels in Liverpool. Photo Chris Rayner

